SOIL SURVEY OF

Starr County, Texas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
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Contents

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

STARR COUNTY is in the extreme southern part of Texas, and its southern boundary is the Rio Grande (fig. 1), which forms the international boundary between the United States and Mexico. It has nearly level to undulating topography in most areas, but is rolling or hilly in a few areas. The total area is 776,960 acres, or 1,214 square miles. Rio Grande City, the county seat, is 104 miles northwest of Brownsville, the southernmost point in Texas.

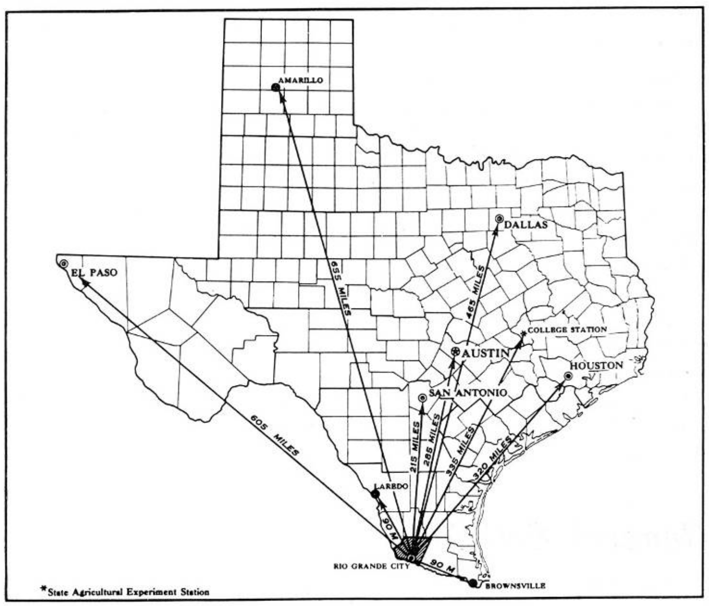

Figure 1.—Location of Starr County in Texas.

Much of Starr County was originally surveyed by Spanish engineers in 1767 and divided into grants called porciones. Consequently, the county is not sectionalized but has the survey lines of the original Spanish grants. It was one of three counties created in the lower valley of the Rio Grande immediately after the end of the Mexican War in 1848. Fort Ringgold, at Rio Grande City, was established in 1848. In 1929 the first oil well began producing, and since that time several hundred wells have been drilled and several oil and gas fields have been discovered.

Throughout the history of the county, livestock has been the stable means of livelihood for most of the people. About 90 percent of the county is used for range, and in 1966, about 10 percent, or 75,000 acres, was cultivated. About 35,000 acres under cultivation was irrigated.

The most prominent landscape feature is the line of low hills that forms the boundary between the flood plain of the Rio Grande and the plain to the north. The ridges are gravelly and highly dissected. They form an escarpment 50 to 100 feet above the flood plain.

West of Los Olmos Creek, which is approximately the southern extension of the west-facing Bordas escarpment; there is a gently rolling plain that has rounded hills and broad valleys. Some of the hills are 50 to 100 feet higher than the surrounding plains. These hills are drained by a number of arroyos that empty into the Rio Grande. The channels of the arroyos are quite prominent and reflect an older, more mature landscape. After heavy rainfall, runoff is rapid and severe flooding is common, especially in the lower reaches of the arroyos.

The eastern part of the county is nearly level and is characterized by small enclosed depressions and weakly defined intermittent drainageways. The dip slope of this general area is to the east and southeast at a gradient of about 10 feet per mile (2).

A minor but prominent landscape feature is the sand sheet that covers the extreme northeastern part of the county. This area is the southwestern extension of an area of windblown sand that covers about 2,800 square miles in southern Texas. In this area the topography is generally gently sloping to rolling or dunelike. There is no drainage pattern in this area.

The terraces and flood plains, which are parallel or adjacent to the river, are as much as 3 miles wide in places, but there is only a narrow channel along the bluffs in the western part of the county. Major runoff in the lower reaches of Garcias Creek and Olmitos Creek and flooding on the nearly level terraces along the Rio Grande are controlled by seven watershed structures built under Public Law 566.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Starr County, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to find many soils that they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles.

A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey (9).

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Brennan and Rio Grande, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Rio Grande silt loam, 0 to 1 percent slopes, is one of three phases within the Rio Grande series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show rangeland, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from these aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Starr County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a, hyphen. Tiocano-Rio complex is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Jimenez-Quemado association is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils. Zapata soil is an example.

There are places where the soil material is so shallow, so severely eroded, or so frequently moved about by water that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in Starr County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Starr County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, drainage, and other characteristics that affect their management.

The soil associations in Starr County are discussed in the following pages. The terms for texture used in the descriptive heading of the associations apply to the entire profile.

1. McAllen-Brennan association

Nearly level to gently sloping, deep, loamy soils on uplands

This association occupies nearly level to gently sloping, almost featureless plains. The only landscape features are a few, shallow, narrow, intermittent stream valleys; scattered slight depressions that do not have natural drainage; and a few low ridges.

This association makes up about 41 percent of the county, or 318,000 acres. It is about 60 percent McAllen soils and 18 percent Brennan soils. Other soils make up the rest.

McAllen and Brennan soils have similar characteristics and are closely associated geographically (fig. 2). The nearly level Brennan soils generally occupy slightly higher positions than the nearly level to gently sloping McAllen soils. Both of these soils occur as large areas that range from 30 to 500 acres in size. They are deep, light brownish-gray and brown soils that have a surface layer of friable fine sandy loam. Below the surface layer is friable sandy clay loam. The McAllen soils are calcareous throughout. The Brennan soils are noncalcareous in the upper layers.

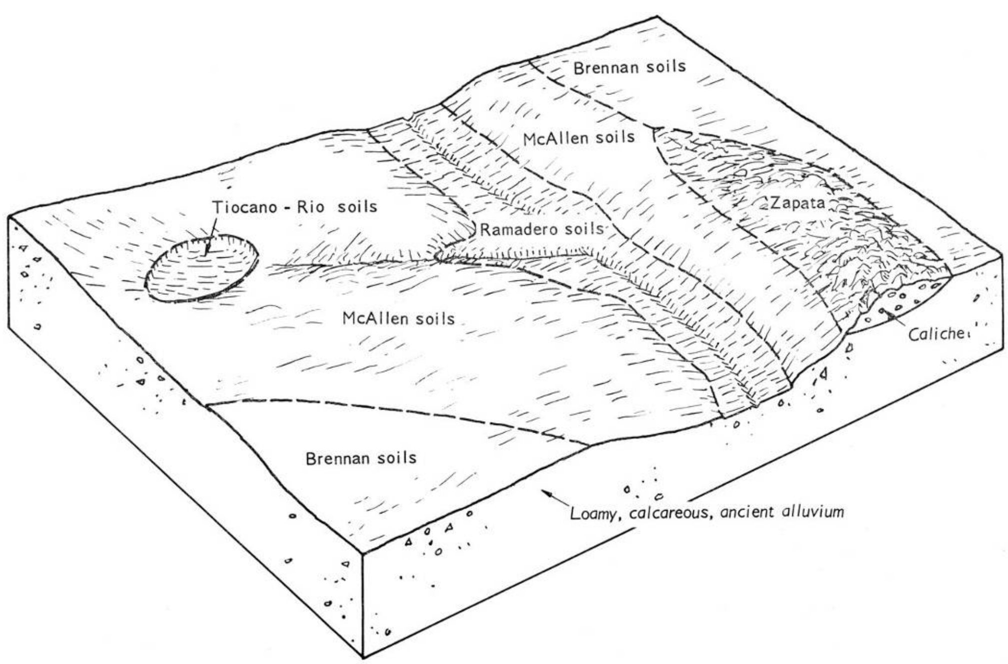

Figure 2.—Pattern of the soils in association 1 and their relationship to underlying material.

Soils of the Zapata, Ramadero, Tiocano, and Rio series make up the rest of this association. Zapata soils, which are very shallow, occur on ridges throughout the association. They are underlain by cemented caliche at a depth of less than 10 inches, and there are a few outcrops of caliche or rock. Ramadero soils, which are deep, occur in narrow valleys. Tiocano and Rio soils occur in circular depressions that do not have natural drainage outlets.

About 90 percent of this association is used for range, and about 10 percent is cultivated, mostly in scattered fields. Some areas have been seeded to introduce varieties of perennial grasses and are used for pasture. The soils are naturally fertile, but lack of rainfall is a severe limitation in most years. These soils are well suited to irrigation.

2. Catarina-Copita association

Nearly level to undulating, deep and moderately deep, clayey and loamy soils on uplands

This association occupies nearly level to undulating uplands where water erosion is a hazard.

This association makes up about 19 percent of the county, or 149,000 acres. It is about 40 percent Catarina soils and about 30 percent Copita soils. Other soils make up the rest.

Catarina soils are deep. They have a light brownish-gray, calcareous, clayey surface layer over firm to extremely firm, saline clay.

Copita soils are moderately deep. They have a surface layer of light brownish-gray, calcareous fine sandy loam over friable sandy clay loam that, in most places, is underlain by calcareous sandstone.

Soils of the Montell and Zapata series make up the rest of this association. The Montell soils, which are level, saline, and clayey, occupy the valley floor. Zapata soils, which are very shallow, occupy the ridges.

This association is better suited to range than to other purposes, and most of the acreage is used for range. Good range management is important in checking excessive loss of soil through erosion.

3. McAllen-Zapata association

Nearly level to gently sloping, deep and very shallow, loamy soils on uplands

This association occupies nearly level to gently sloping plains that are dissected by small, shallow, narrow drainageways.

This association makes up about 14 percent of the county, or about 105,000 acres. It is about 55 percent McAllen soils and about 25 percent Zapata soils. Other soils make up the rest.

McAllen soils occur as broad areas. They are deep and have a surface layer of light brownish-gray, calcareous fine sandy loam. The next layer is friable sandy clay loam, and the underlying material is calcareous sandy clay loam.

Zapata soils generally occur on ridges or on higher parts of the landscape. These are gently sloping, light brownish-gray soils that are very shallow over white, strongly cemented caliche.

Soils of the Brennan and Ramadero series make up a part of this association. Brennan soils, which are deep fine sandy loams, occur in smooth areas of the landscape. Ramadero soils, which are deep, occupy the narrow valleys that dissect the landscape.

Most of this association is used for range. Only a few, small, widely scattered fields of McAllen soils are farmed. The soils are fertile, but in most years, the low rainfall is a severe limitation. Zapata soils are not suitable for cultivation.

4. Copita association

Nearly level to gently undulating, moderately deep, loamy soils on uplands

This association occupies nearly level to gently undulating uplands where erosion is a hazard.

This association makes up about 6 percent of the county, or 50,000 acres. It is about 75 percent Copita soils. Other soils make up the rest.

Copita soils, which are predominant in this association, are moderately deep. They have a surface layer of light brownish-gray, calcareous fine sandy loam over friable sandy clay loam. In most places this material is underlain by calcareous sandstone.

Soils of the Catarina, Garceno, and Montell series make up the rest of this association. These soils are more clayey than Copita soils. Catarina soils occur in lower positions on the landscape, and Garceno and Montell soils, which are nearly level, are on the valley floors.

Most of this association is used for range. The soils are droughty because they have a high content of lime and because the rainfall is low and erratic. Consequently, dry-farming is risky. The soils are suited to perennial grasses.

5. Delmita association

Nearly level to gently sloping, moderately deep, loamy soils underlain by indurated caliche; on uplands

This association occupies nearly level to gently sloping almost featureless plains.

This association makes up about 6 percent of the county, or 48,000 acres. It is about 75 percent Delmita soils. Other soils make up the rest.

Delmita soils are moderately deep. They have a surface layer of reddish-brown, fine sandy loam and loamy fine sand. The next layer is red, friable sandy clay loam to fine sandy loam. Indurated caliche is at a depth of less than 40 inches.

Soils of the Brennan, McAllen, and Comitas series make up a part of this association. Although in the same landscape, Brennan and McAllen soils are not as reddish as Delmita soils, and they lack indurated caliche at a depth of less than 40 inches. Comitas soils occupy slightly higher positions on the landscape than Delmita soils. They generally appear as mounds or hummocks. They have a slightly more sandy material below the surface layer than Delmita soils and they are not underlain by indurated caliche.

Most of this association is used for native range, but about 20 percent is cultivated. A few old fields are used for improved pasture. The soils are fertile, but in most years, the lack of rainfall is a limitation. These soils are well suited to grasses.

6. Rio Grande-Reynosa association

Nearly level and gently sloping, deep, loamy soils on flood plains

This association occupies the nearly level to gently sloping flood plain and low terraces along the Rio Grande. The soil areas parallel the river and are about 3 to 4 miles wide. They are within the present flood plain of the Rio Grande and are flooded infrequently. The principal landscape features are a few abandoned river channels or oxbows and a few low escarpments.

This association makes up 6 percent of the county, or 44,000 acres. It is 28 percent Rio Grande soils and 15 percent Reynosa soils. Other soils make up the rest.

Rio Grande soils are on the present flood plain of the river. They are deep and calcareous. They have a surface layer of light brownish-gray, friable silt loam. Below this is friable, stratified silt loam.

Reynosa soils are in slightly higher terrace positions. They are calcareous. They have a surface layer of grayish-brown silty clay loam. The next layer is friable silty clay loam.

Soils of the Zalla, Camargo, Lagloria, Matamoros, and Grulla series make up a part of this association. Zalla soils, which consist of loose loamy fine sand, are adjacent to the river. Camargo, Matamoros, and Grulla soils, all of which are more clayey than Rio Grande soils, are on the flood plain. Matamoros and Grulla soils occupy the low areas, and the Grulla soils remain wet for several weeks or months each year. Lagloria soils, which are less clayey than Reynosa soils, occupy terraces or slightly higher positions on the landscape.

About 75 percent of this association is cultivated and irrigated, but most of the remaining 25 percent is brushy and used for range. The soils are fertile. In dryfarmed areas, the low rainfall is a limitation in most years.

7. Sarita association

Nearly level to gently undulating, deep, sandy soils on uplands

This association occupies nearly level to gently undulating, eolian plains.

This association makes up about 5 percent of the county, or about 40,000 acres. It is about 75 percent Sarita soils. Other soils make up the rest.

Sarita soils are deep. They have a surface layer of brown or pale-brown, loose, structureless fine sand. Mottled sandy clay loam occurs at a depth ranging from 40 to 60 inches.

Soils of the Falfurrias, Comitas, and Delmita series make up a part of this association. Falfurrias soils, all of which are deep, loose, and have a texture of fine sand, occur in areas of low-dune topography. Comitas and Delmita soils are less sandy than Sarita soils. Also, Delmita soils have a reddish-brown surface layer and cemented caliche at a depth of less than 40 inches.

Almost all of this association is used for range, but in years when rainfall is above average, a few scattered fields of Sarita soils are cultivated. The soils are droughty and are susceptible to soil blowing when bare. The low rainfall is a severe limitation if the soils are used for crops.

8. Jimenez-Quemado association

Undulating to hilly, very gravelly, shallow, loamy soils on ridges

This association occupies the undulating to hilly gravelly ridges that make up the escarpments above the terraces and flood plains along the Rio Grande (fig. 3). The major soils are a source of gravel, and there are several large pits in this association.

This association makes up about 3 percent of the county, or 22,000 acres. It is about 52 percent Jimenez soils and 38 percent Quemado soils. Other soils make up the rest.

Jimenez soils occupy the more strongly sloping parts of the undulating to hilly landscape. They are shallow, brown, calcareous soils that have a texture of very gravelly loam. The underlying material is cemented caliche that contains rounded gravel.

Quemado soils occur as a narrow band at the top of ridges. They are generally less sloping than Jimenez soils. They are reddish-brown, noncalcareous soils. The underlying material is cemented caliche that contains rounded gravel.

Soils of the Ramadero, McAllen, and Brennan series, all of which are deep, make up a part of this association.

All of this association is well suited to and is used for range. The soils respond to mechanical brush control and seeding.

Descriptions of the Soils

In this section the soils of Starr County are described in detail. The procedure is to describe first the soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

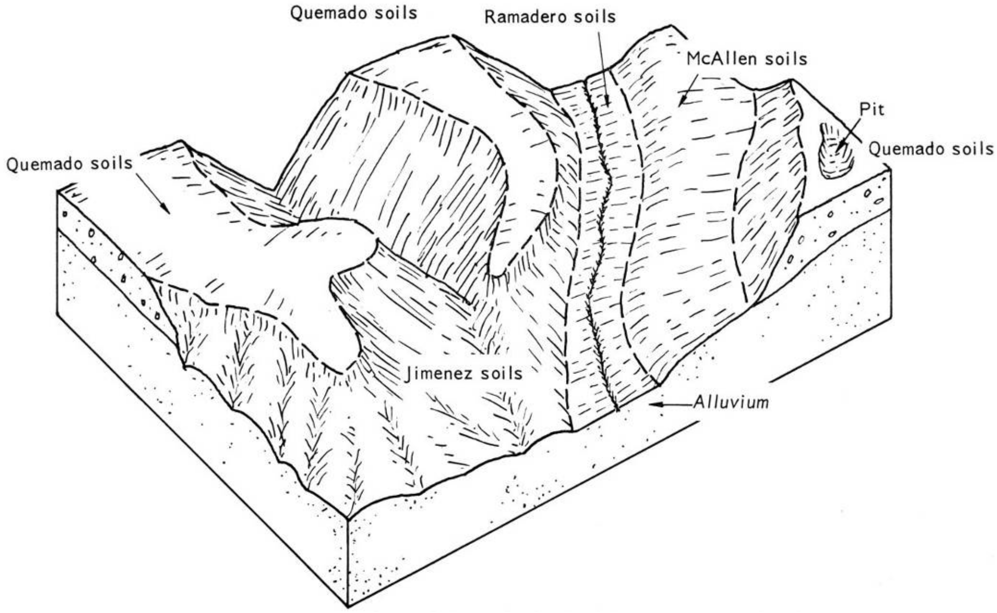

Figure 3.—Pattern of the soils in association 8 and their relationship to underlying material.

Each series description contains a short narrative description of a soil profile considered representative of the series and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The colors described are for dry soils, unless otherwise noted. The lower depths given in inches in the detailed descriptions denote the depths to which the soils were examined. Many of the terms used in describing soil series and mapping units are defined in the Glossary, and some are defined in the section "How This Survey Was Made."

The approximate acreage and proportionate extent of the soils are shown in table 1. The "Guide to Mapping Units" lists the mapping units of the county and shows the nonirrigated and irrigated capability units, the range site, and the wildlife group each mapping unit is in. It also shows the pages where the mapping units, capability units, and range sites are described.

Alluvial Land

Alluvial land (Al) consists of deep, nearly level to sloping, loamy alluvium. This land type occurs as narrow, elongated areas along the Rio Grande (fig. 4). These areas are generally less than 20 feet above the riverbed and are flooded at intervals ranging from once every year to once in 3 years. The topography is altered with each of the floodwater deposits. The slope range is 0 to 8 percent.

The texture at the surface is commonly silt loam, but it ranges from silty clay loam to loamy fine sand. The stratified underlying layers range from silty clay loam to loamy fine sand in texture. The bedding planes created by each floodwater deposit are evident. In some areas there are strata of sand that have little or no clay or silt.

Included in mapping were gullies, low escarpments, and scour areas that have no vegetation.

Some areas of this land type are only a few feet above the riverbed and are subirrigated. These areas are well suited to native grasses. The higher and more sloping areas are droughty. This land type is not suitable for cultivation, because of the flooding and the topography. (Capability unit Vw-2, nonirrigated; Loamy Bottomland range site)

Figure 4.—Area of Alluvial land along the Rio Grande.

Brennan Series

The Brennan series consists of deep, well-drained, nearly level soils on uplands. These soils developed in friable, loamy sediments that have a high content of lime.

In a representative profile the surface layer is brown fine sandy loam about 12 inches thick. The next layer is friable sandy clay loam about 28 inches thick. This layer is yellowish brown in the upper part and light yellowish brown in the lower part. A few threads and soft lumps of calcium carbonate are in the lower part. The underlying material, to a depth of about 84 inches, is very pale brown sandy clay loam that contains soft lumps and concretions of calcium carbonate. The lumps and concretions make up about 10 percent of the material.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Brennan soils are used mainly for range, but a few areas are dryfarmed. Some areas that were formerly cultivated have been seeded to pasture.

Representative profile of Brennan fine sandy loam, 22 miles northeast of Rio Grande City, in a pasture 200 feet west of county road (400 feet south of cattle guard) and 1.6 miles south of intersection of county road and Farm Road 2294. This intersection is 5.4 miles southwest of Sun Oil Company camp (via road).

A1—0 to 12 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, subangular blocky structure (uppermost 2 inches is structureless); hard when dry, friable when moist; neutral; gradual, wavy boundary.

B2t—12 to 26 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; many fine pores; many root channels; few patchy clay films in pores; mildly alkaline; diffuse, wavy boundary.

B3—26 to 40 inches, light yellowish-brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; many fine pores; few threads and soft lumps of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

Cca—40 to 84 inches, very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; few fine pores; soft lumps and concretions of calcium carbonate make up about 10 percent, by volume, but the percentage decreases slightly as depth increases; calcareous; moderately alkaline.

The A horizon ranges from 8 to 16 inches in thickness, and from dark grayish brown to brown in color. The B horizon ranges from 18 to 34 inches in thickness, from brown to light yellowish brown in color, and from fine sandy loam to sandy clay loam in texture. The B2t horizon has weak to moderate, coarse, prismatic structure ranging to weak, subangular blocky. The soil is leached of lime to a depth of 15 to 28 inches. The amount of visible lime in the Cca horizon ranges from 5 to 20 percent, by volume. The depth to the Cca horizon ranges from 32 to 45 inches.

Brennan fine sandy loam (Br).—Areas of this soil are broad, irregularly shaped, and as much as several acres in size. There are few observable landscape features. The slopes are convex; the gradient is generally less than 1 percent, but it ranges from 0 to 2 percent.

Included in mapping were areas of McAllen fine sandy loam, a few areas of Delmita fine sandy loam, and a few areas of Zapata soils on narrow ridges. Also included were areas of Ramadero loam in small depressions and narrow natural drainageways.

Most of the acreage is used for range (fig. 5). This soil is suited to irrigated crops, and a few fields are irrigated. Some scattered fields are dryfarmed: Farming is risky because of the low, erratic rainfall. Surface runoff is slow. (Capability units IIIc-1, nonirrigated, I-1, irrigated; Sandy Loam range site)

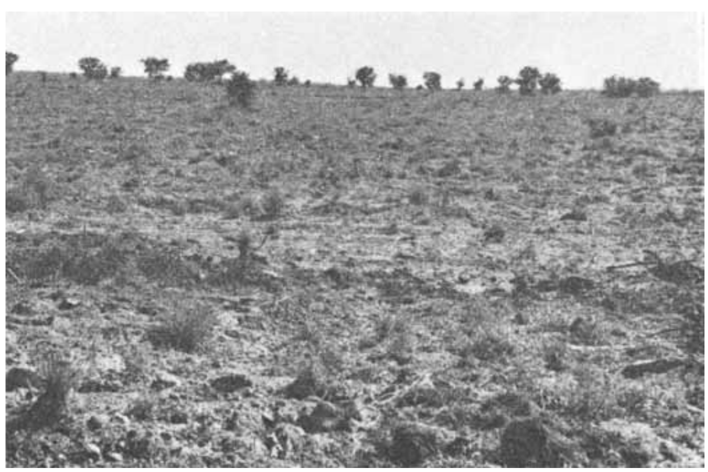

Figure 5.—Area of Brennan fine sandy loam that has been recently root-plowed and seeded.

Camargo Series

The Camargo series consists of deep, well-drained, level soils on the active part of the flood plain of the Rio Grande and on alluvial fans of its major tributaries. These soils are flooded infrequently or about once in 10 years.

They developed in recently deposited, friable, stratified sediments that have a high content of lime. The slope is mainly less than 1 percent, but it is as much as 3 percent in places.

In a representative profile the surface layer is light brownish-gray silty clay loam about 9 inches thick. The underlying material, to a depth of about 63 inches, is light brownish-gray, friable silty clay loam that is stratified with thin layers of silt loam.

Internal drainage is slow, permeability is moderate, and the available water capacity is high.

Camargo soils are used mainly for irrigated crops. They are well suited to cool-season vegetables as well as a number of other crops. A few areas remain in range.

Representative profile of Camargo silty clay loam, 0 to 1 percent slopes, 100 feet south of a private road from a point one-half mile west of a brick plant and the intersection of the private road and U.S. Highway 83. This intersection is about 8 miles southeast by east from Rio Grande City.

Ap—0 to 9 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; compact; few mica flakes; calcareous; abrupt, smooth boundary.

C—9 to 63 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; stratified with thin layers and lenses of silt loam; structureless; bedding planes evident; hard when dry, friable when moist; many fine pores; few worm casts; few mica flakes; calcareous.

The A and C horizons range from grayish brown to pale brown in color. At a depth between 10 and 40 inches, the soil material ranges from silt loam to silty clay loam in texture and is about 18 to 35 percent clay. There are strata, less than 6 inches thick, of more clayey or more sandy material. The cleavage lines along the bedding planes are weakly to strongly expressed. At a depth below 40 inches, the sediments are stratified and range from fine sandy loam to silty clay in texture.

Camargo silty clay loam, 0 to 1 percent slopes (CaA).—Areas of this soil are broad, irregularly shaped, and several hundred acres in size. This soil has the profile (fig. 6) described as representative of the series.

Included in mapping were spots of Rio Grande silty clay loam; a few areas of Matamoros silty clay, which occur at slightly lower elevations; and areas where the slope is 1 to 3 percent on narrow, elongated natural levees. Also included were areas of Reynosa silty clay loam.

This soil is well suited to most crops, and most of the acreage is cultivated and irrigated. After heavy irrigation or heavy rainfall, a perched water table is common because the lower layers have contrasting soil textures. A few fields are dryfarmed, but dryfarming is risky because of the climate. Surface runoff is slow. (Capability units IIIc-2, nonirrigated, and I-2, irrigated; Loamy Bottomland range site)

Camargo silty clay loam, 1 to 3 percent slopes (CaB).—Areas of this soil are narrow, convex, mainly elongated, and generally less than 50 acres in size. They are on natural levees adjacent to resacas or escarpments within the flood plain of the Rio Grande.

Typically, the surface layer or plowed layer of this soil is light brownish gray, friable, calcareous silty clay loam about 6 inches thick. The next layer, to a depth of about 40 inches, is light brownish gray, friable calcareous silty clay loam stratified with layers of very fine sandy loam, loamy fine sand, and silt loam. These layers range from 1 to 4 inches in thickness. Horizontal bedding planes are evident. Some yellowish-brown mottles occur on the faces of the strata. The underlying sediments, to a depth below 60 inches, are brownish and are stratified with more clayey or sandy materials.

Included in mapping were spots of Camargo silty clay loam, 0 to 1 percent slopes, which occur in lower positions, and a few elongated areas of Rio Grande silt loam, 1 to 3 percent slopes.

Figure 6.—Profile of Camargo silty clay loam.

This soil is well suited to most crops, and most of the acreage is cultivated and irrigated. Landforming operations are needed in developing an irrigation system. A few areas are idle. Surface runoff is medium. (Capability units IIIe-1, nonirrigated, and IIe-1, irrigated; Loamy Bottomland range site)

Catarina Series

The Catarina series consists of deep, undulating, clayey soils on uplands. These soils developed in calcareous, gypsiferous, saline clay and shaly clay. The slopes are convex, and the slope range is 1 to 5 percent.

In a representative profile (fig. 7) the surface layer is clay about 21 inches thick. It is light brownish gray in the uppermost 2 inches and grayish brown below this depth.

The next layer, about 9 inches thick, is grayish-brown, extremely firm clay that has streaks and tongues of yellowish brown. Below this is light yellowish-brown, very firm clay about 7 inches thick. The underlying material, to a. depth of 60 inches, is olive-yellow clay that contains calcium carbonate concretions and gypsum crystals.

The available water capacity is low to high, depending on the salinity.

Catarina soils are used for range. They are not cultivated, because they have a high content of salt and because the climate is dry.

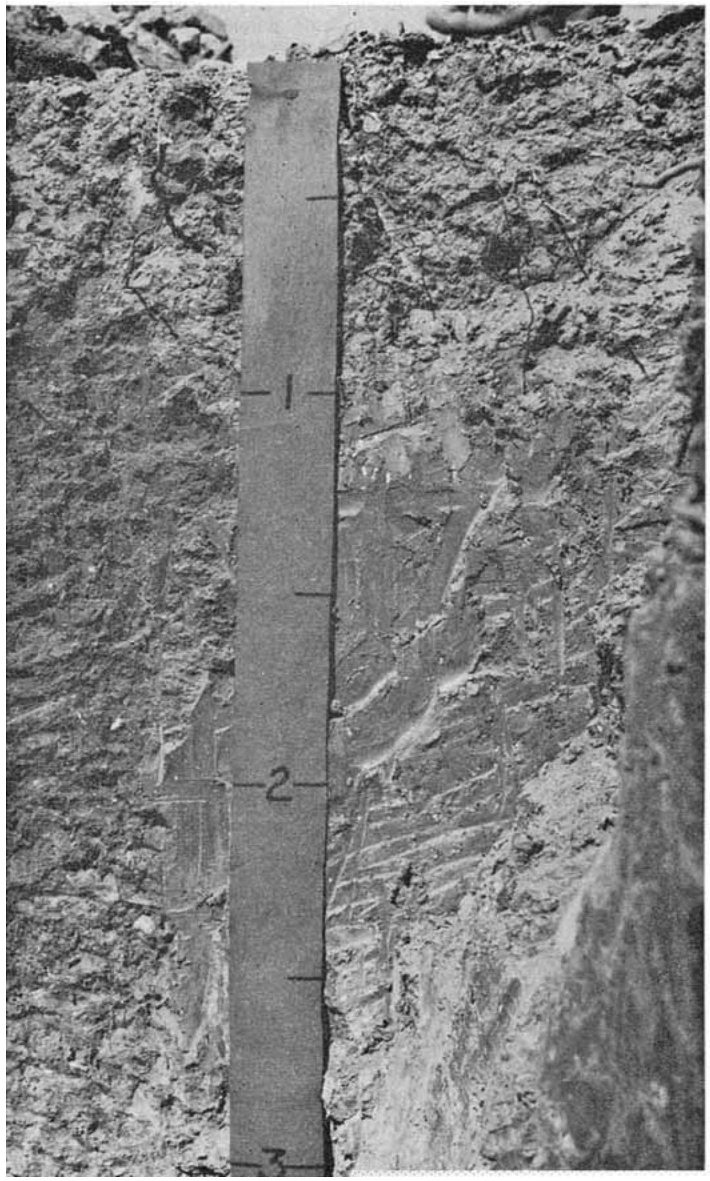

Figure 7.—Profile of Catarina clay.

Representative profile of Catarina clay, in an area of Catarina soils, 100 feet west of Loma Blanca Road, 10 miles north of its intersection with U.S. Highway 83 and 4 miles north of Roma.

A11—0 to 2 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; few broken snail shells and chert fragments on the surface; calcareous; moderately alkaline; abrupt, wavy boundary.

A12—2 to 10 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, fine and medium, blocky structure; extremely hard when dry, very firm when moist; few root channels; few chert and quartz fragments; calcareous; moderately alkaline; gradual, wavy boundary.

A13—10 to 21 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, fine and medium, blocky structure; the peds are wedge-shaped; very hard when dry, extremely firm when moist; few salt threads; common dark-brown spots, about 10 millimeters wide, of organic material in different stages of decomposition, apparently along old cracks; saline; calcareous; strongly alkaline; gradual, wavy boundary.

AC1—21 to 30 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; streaks and tongues of light yellowish brown (2.5Y 6/4); moderate, blocky structure; very hard when dry, extremely firm when moist; slickensides intersect and are about 6 inches long and 4 inches wide; few salt crystals; brownish spots of organic material as in the A13 horizon; saline; calcareous; moderately alkaline; clear, wavy boundary.

AC2sa—30 to 37 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; a few streaks of grayish brown; weak blocky structure; very hard when dry, very firm when moist; common slickensides as in the AC1 horizon; few salt crystals; few cracks not completely closed; few brown streaks of organic material; saline; calcareous; moderately alkaline; diffuse, broken boundary.

AC3ca—37 to 48 inches, olive-yellow (2.5Y 6/6) clay, light olive brown (2.5Y 5/6) when moist; weak blocky structure; firm; about 5 percent, by volume, is calcium carbonate concretions; a few vertical cracks about 5 millimeters wide; fewer brownish spots of organic material than in the AC2sa horizon; few gypsum crystals; saline; calcareous; moderately alkaline; diffuse, broken boundary.

C—48 to 60 inches, olive-yellow (2.5Y 6/6) clay, light olive brown (2.5Y 5/6) when moist; weak blocky structure; very hard when dry, very firm when moist; few calcium carbonate concretions, gypsum crystals, and shell fragments; saline; strongly calcareous; moderately alkaline.

The A horizon ranges from about 15 to 26 inches in thickness and from grayish brown to light yellowish brown in color. The AC horizon ranges from 15 to 30 inches in thickness and from grayish brown to pale olive in color. The C horizon is brownish- to olive-colored clay or shaly clay that contains calcium carbonate, gypsum crystals, and other visible salts. These concretions make up 5 to 20 percent, by volume, of the C horizon, and they are generally slightly more concentrated in the upper part. These soils are either not saline or are only slightly affected by salinity in the uppermost 10 inches and moderately to strongly affected below this depth. Fragments of caliche and marine shells and rounded fragments of chert make up 1 to 10 percent, by volume, of the soil.

Catarina soils (Cn).—Areas of these soils are irregularly shaped or elongated and are as much as several hundred acres in size. They are dissected by many drainageways and by a few shallow gullies and rills. In most areas the gullies and rills are small and crossable, but there are a few large gullies kept active by runoff. Sheet and gully erosion have been active in most places. The slope range is 1 to 5 percent.

Included in mapping were areas of Maverick soils, eroded, and a few elongated areas of Garceno clay loam along drainageways. Also included were areas of very shallow Zapata soils on ridges.

All the acreage is used for range (fig. 8). The revegetation of native and improved varieties of grass is difficult. The soils are droughty because runoff is very rapid and the soil material is clayey and highly saline. (Capability unit VIIs-1, nonirrigated; Saline Clay range site)

Figure 8.—Typical native vegetation on Catarina soils.

Comitas Series

The Comitas series consists of deep, well-drained, nearly level to gently undulating soils of the uplands. These soils developed in very friable sandy material that has been reworked by wind. The slopes are convex; the gradient is less than 3 percent.

In a representative profile the surface layer is brown loamy fine sand 22 inches thick. The next layer, to a depth of 46 inches, is reddish-brown, very friable fine sandy loam. Below this, to a depth of 74 inches, is yellowish-red loamy fine sand. The underlying material is reddish-yellow loamy fine sand to a depth of 85 inches.

Internal drainage is rapid, permeability is moderately rapid, and the available water capacity is moderate.

Comitas soils are used mainly for range. A few areas are dryfarmed, but soil blowing is a hazard. Some areas that were once cultivated have been seeded to grasses and used for tame pasture.

Representative profile of Comitas loamy fine sand, 150 feet west of Farm Road 755 and 0.9 mile southwest of La Gloria.

A11—0 to 11 inches, brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) when moist; structureless; soft when dry, very friable when moist; many fine roots; porous; neutral; diffuse, wavy boundary.

A12—11 to 22 inches, brown (10YR 4/3) loamy fine sand, dark yellowish brown (10YR 3/4) when moist; weak prismatic structure; slightly hard when dry, very friable when moist; many fine roots; porous; neutral; diffuse, wavy boundary.

B2t—22 to 46 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, prismatic structure; slightly hard when dry, very friable when moist; few roots; porous; clay coatings and bridging of sand grains; neutral; diffuse, wavy boundary.

B3—46 to 74 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) when moist; very weak prismatic structure; soft when dry, very friable when moist; mildly alkaline; gradual, wavy boundary.

Cca—74 to 85 inches, reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) when moist; structureless; soft when dry, very friable when moist; porous; few, fine, soft lumps of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 20 to 30 inches in thickness and from dark grayish brown to brown in color. The Bt horizon ranges from 15 to 30 inches in thickness, from reddish brown or brown to strong brown or yellowish red in color, and from fine sandy loam to loamy very fine sand in texture. In most profiles the soil material is noncalcareous to a depth of 50 to about 80 inches, but in some profiles there is a layer of lime accumulation at depths between 50 and 80 inches. The amount of lime in this layer ranges from 1 to 5 percent, by volume.

Comitas loamy fine sand (Co).—Areas of this soil are smooth to dunelike in appearance. They are elongated with the long axis parallel to the prevailing southeasterly winds. They are 60 to 300 acres in size. The slope is dominantly less than 2 percent, but the slope range is 0 to 3 percent. Included in mapping were areas of Sarita fine sand, which occupy the higher convex mounds.

Most of the acreage is used for range. Dryfarming is risky because the low erratic rainfall is not favorable. Plants respond to small amounts of rainfall. Runoff is slow. (Capability units IIIe-2, nonirrigated, and IIIs-1, irrigated; Loamy Sand range site)

Copita Series

The Copita series consists of moderately deep, well-drained, nearly level to gently undulating soils of the uplands. These soils are droughty as a result of the high lime content. The slopes are convex; the gradient is less than 3 percent.

In a representative profile the surface layer is mainly grayish-brown fine sandy loam about 11 inches thick. The next layer, to a depth of 26 inches, consists of pale-brown friable sandy clay loam and a few films and threads of calcium carbonate. Below this, to a depth of 37 inches, is light yellowish-brown friable sandy clay loam that contains many films and threads of calcium carbonate. The underlying bedrock is calcareous sandstone.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Copita soils are used mainly for range, but a few areas are dryfarmed. Some areas that were formerly cultivated have been seeded to grasses and used for pasture.

Representative profile of Copita fine sandy loam, 240 feet west of Loma Blanca Road, and 1.2 miles north of the intersection of Loma Blanca Road and U.S. Highway 83. This intersection is 4.0 miles north-northwest of Roma.

A11—0 to 2 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; few shell fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

A12—2 to 11 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; compound, moderate, coarse, prismatic and weak, subangular blocky structure when dry, but structureless when moist; hard when dry, friable when moist; porous; few films and threads of segregated carbonates; calcareous; moderately alkaline; clear, smooth boundary.

B2—11 to 26 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; compound, moderate, coarse, prismatic and weak, subangular blocky structure when dry, but weak, subangular blocky when moist; hard when dry, friable when moist; numerous roots; porous; few shell fragments; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—26 to 37 inches, light yellowish-brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; few roots; porous; few broken snail shells; many films and threads of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

R1&Cca—37 to 49 inches, very pale brown (10YR 7/3), weakly cemented calcareous sandstone that has thin strata and pockets of sandy loam; fractured; brittle; a few roots in the sandy loam in crevices; estimated 5 percent, by volume, of calcium carbonate as coatings on upper boundary and in fractures or partings; calcareous; moderately alkaline; gradual, wavy boundary.

R2—49 to 54 inches, very pale brown (10YR 7/3), strongly cemented, calcareous sandstone; calcium carbonate coatings in a few fractures.

The A horizon ranges from 6 to 16 inches in thickness and from grayish brown to light brownish gray or pale brown in color. The B2 horizon ranges from 11 to 18 inches in thickness. The B horizon ranges from pale brown to very pale brown or light yellowish brown in color and from fine sandy loam to sandy clay loam or loam in texture. The depth to the R layer ranges from 25 to 40 inches. The R layer consists of weakly to strongly cemented sandstone and pockets of sandy loam and weakly cemented, loamy, old alluvium.

Copita fine sandy loam (Cp).—Areas of this soil are elongated or irregularly shaped and range from 50 to several hundred acres in size. The slope range is 0 to 3 percent.

Included in mapping were areas of McAllen fine sandy loam and a few spots of Zapata soils, which are on small ridges. Also included were a few eroded spots and areas where the slopes are as much as 5 percent.

Most of the acreage is used for range (fig. 9), but scattered fields are dryfarmed. Dryfarming is risky because the low, erratic rainfall and the droughtiness of the soil caused by the high content of lime are unfavorable. Revegetation can take place, and the potential for grass production is good. The control of water erosion is a problem where the slope is more than 2 percent if the natural plant cover is removed. Surface runoff is slow. (Capability units VIc-1, nonirrigated, and IIe-2, irrigated; Gray Sandy Loam range site)

Figure 9.—Typical native vegetation on Copita fine sandy loam.

Delmita Series

The Delmita series consists of moderately deep, well-drained, nearly level to gently sloping soils of the uplands. These soils developed in very friable loamy materials that have been reworked by wind. The slopes are convex; the gradient is less than 3 percent.

In a representative profile the surface layer is reddish-brown fine sandy loam about 14 inches thick. The next layer is red, friable sandy clay loam about 16 inches thick. The underlying material is white caliche to a depth of about 60 inches. The caliche is indurated in the upper part but becomes less cemented with increasing depth.

Internal drainage is medium, permeability is moderate, and the available water capacity is moderate.

Delmita soils are used for range and for nonirrigated crops. Some areas that were formerly cultivated have been seeded to grasses and used for pasture.

Representative profile of Delmita fine sandy loam, 150 feet west of Farm Road 2294 and 1,800 feet south of its intersection with Farm Road 1017, which is 5.5 miles east of La Gloria.

A1—0 to 14 inches, reddish-brown (5YR 5/4) fine sandy loam, slightly darker (5YR 4/4) when moist; structureless; hard when dry, friable when moist; neutral; clear boundary.

B2t—14 to 30 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure breaking to weak, subangular blocky; very hard when dry, friable when moist; few fine and very fine pores and root channels; few clay films on ped faces and in pores; neutral; abrupt, wavy boundary.

IICcam—30 to 60 inches, white (10YR 8/2), dry caliche; thick, platy and etched, finely laminated, and indurated in upper part and has a hardness of 3 on the Mohs scale, but less cemented and massive or concretionary with increasing depth.

The A horizon ranges from 9 to 18 inches in thickness, from reddish brown to strong brown in color, and from fine sandy loam to loamy fine sand in texture. Fragments of indurated caliche, 2 to 3 inches in diameter, make up as much as 5 percent, by volume, of the soil material, but in some places, they do not occur. The Bt horizon ranges from 11 to 28 inches in thickness, from dark reddish brown to yellowish red in color, and from fine sandy loam to sandy clay loam in texture. In some areas, there are a few coarse mottles in other shades of red or yellowish brown in the lower few inches. The depth to the layer of strongly cemented or indurated caliche ranges from 20 to 40 inches. Above the layer of caliche, reaction ranges from neutral to mildly alkaline.

Delmita fine sandy loam (De).—Areas of this soil are mainly broad, irregularly shaped, and 20 to several hundred acres in size. The slope is dominantly less than 1 percent, but the slope range is 0 to 3 percent. This soil has the profile described as representative of the series.

Included in mapping were spots of Delmita loamy fine sand; a few areas where Zapata soils and outcrops of indurated caliche occur on ridges; and small areas of Ramadero loam, which are in small depressions and narrow natural drainageways.

Most of the acreage is used for range, but some small areas are dryfarmed each year. Dryfarming is risky because the climate is not favorable. Some areas that were formerly cultivated have been seeded to improved grasses and managed as pasture. Surface runoff is slow. (Capability units IVe-1, nonirrigated, and IIe-3, irrigated; Sandy Loam range site)

Delmita loamy fine sand (Dm).—Areas of this soil are broad, irregularly shaped, and as much as several hundred acres in size. The slopes are convex; the slope range is 0 to 3 percent.

Typically, the surface layer is reddish-brown, loose loamy fine sand about 17 inches thick, but in cultivated fields where some winnowing of the finer particles has taken place, the surface layer is more sandy and slightly lighter colored. The layer is white caliche that is indurated in the upper part but massive and less cemented in the lower part.

Included in mapping were spots of Delmita fine sandy loam and small areas of Sarita fine sand, which occupy slightly higher positions.

Most of the acreage is used for range but small areas are dryfarmed each year. Dryfarming is risky because the climate is unfavorable. Controlling soil blowing is a problem in fields that are bare in spring. Surface runoff is slow. (Capability units IVe-2, nonirrigated, and IIIe-1, irrigated; Loamy Sand range site)

Falfurrias Series

The Falfurrias series consists of deep, somewhat excessively drained, gently undulating to rolling, sandy soils of the uplands. These soils developed in loose fine sand of eolian origin.

In a representative profile the surface layer is pale-brown fine sand about 10 inches thick. The underlying material is light yellowish-brown, loose fine sand to a depth of about 90 inches.

Internal drainage and permeability are rapid, and the available water capacity is low.

Falfurrias soils are used for range. They respond to small amounts of water received as rainfall. The control of soil blowing is a severe problem in bare areas. Careful management of range is needed to prevent blowouts and dunes from forming or to keep them from spreading.

Representative profile of Falfurrias fine sand, 100 feet east of Farm Road 755 and 1.0 mile northeast of the intersection of Farm Road 1017 and Farm Road 755 in La Gloria.

A1—0 to 10 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 4/3) when moist; structureless; loose; visible decaying organic matter, few roots; neutral; clear, smooth boundary.

C—10 to 90 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; structureless; loose; few insect and animal burrows filled with slightly darker colored material; few roots in the upper part; neutral.

The slightly darkened A horizon ranges from 10 to 20 inches in thickness and from grayish brown to light brown in color. Reaction ranges from slightly acid to neutral. The C horizon ranges from light brownish gray to very pale brown in color. In places a few yellowish-brown mottles occur at a depth below 60 inches. Reaction ranges from neutral to moderately alkaline.

Falfurrias fine sand (Fa).—Areas of this soil are gently undulating to dunelike. They are mainly between 50 and 500 acres in size and are elongated with the long axis parallel to the prevailing southeasterly winds. The slope range is 1 to 8 percent. Included in mapping were a few active sand dunes, less than 40 acres in size, and a few areas of Sarita fine sand.

The entire acreage is used for range (fig. 10). The soil is droughty because the available water capacity is low, but plants respond to the small amounts of water received as rainfall because the soil is sandy. Careful management of range is needed to control erosion. Surface runoff is very slow because most of the water enters the soil. (Capability units VIe-1, nonirrigated, and IIIs-2, irrigated; Sandy Mound range site)

Figure 10.—Typical native vegetation on Falfurrias fine sand.

Garceno Series

The Garceno series consists of deep, well-drained, nearly level soils of the uplands. These soils developed in calcareous sediments that contain some salt. They occur in broad, shallow valleys and on outwash plains. The slope is less than 1 percent.

In a representative profile (fig. 11) the surface layer is clay loam about 9 inches thick. This layer is pale brown in the uppermost 2 inches and brown below. The next layer is pale-brown, friable clay loam about 18 inches thick. The underlying material, to a depth of 60 inches, consists of very pale brown clay loam and about 2 percent visible calcium carbonate. The proportion of calcium carbonate decreases with increasing depth.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Garceno soils are used mainly for range. In its native state, the brushy vegetation is dense.

Representative profile of Garceno clay loam, about 12.8 miles north, 5° east of Roma, about 100 feet north of county road and 3,200 feet east of the intersection of the county road with Loma Blanca Road. This intersection is 9 miles north of U.S. Highway 83. (The intersection of Loma Blanca Road and U.S. Highway 83 is 4 miles north of Roma.)

A11—0 to 2 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) when moist; massive in uppermost one-half inch, but weak, granular structure below; slightly hard and crumbles to a mixture of indistinct very fine granules and much unaggregated powder when dry; very friable when moist; few, rounded, siliceous pebbles less than 4 centimeters in diameter are on the surface; calcareous; clear, smooth boundary.

A12—2 to 9 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; few, rounded, siliceous pebbles less than 4 centimeters in diameter; few threads of segregated lime; few broken snail shells; calcareous; diffuse, wavy boundary.

B2—9 to 27 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 4/3) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; few insect burrows and worm casts; less than 2 percent, by volume, of rounded siliceous pebbles up to 2 centimeters in diameter; common threads and films of calcium carbonate; calcareous; diffuse, wavy boundary.

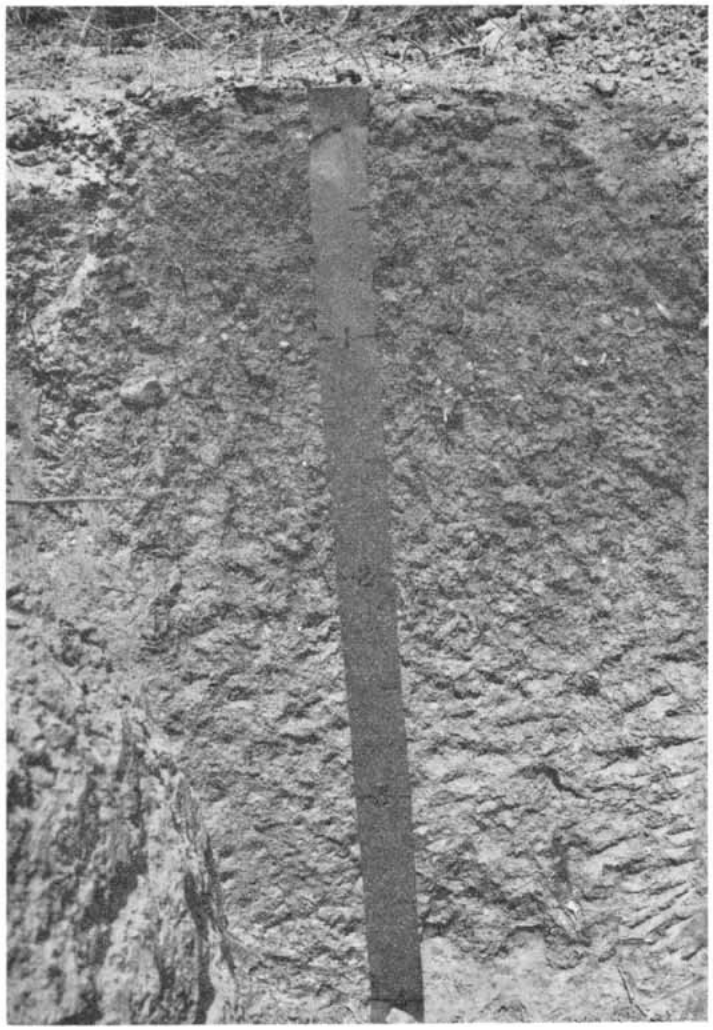

Figure 11.—Profile of Garceno clay loam.

C1ca—27 to 34 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) when moist; apparently structureless; hard when dry, friable when moist; about 5 percent, by volume, of rounded pebbles up to 2 centimeters in diameter; about 2 percent visible calcium carbonate in the form of soft lumps, threads, and films; saline; calcareous; gradual, wavy boundary.

C2—34 to 60 inches, very pale-brown (10YR 7/3) clay loam; structureless; hard when dry, friable and crumbly when moist; few rounded siliceous pebbles; few soft lumps and common films and threads of calcium carbonate; saline; calcareous.

The A horizon ranges from 7 to 12 inches in thickness and from light brownish gray to pale brown or brown in color. The B horizon ranges from 15 to 24 inches in thickness, from grayish brown to very pale brown in color, and from clay loam or sandy clay loam to clay in texture. The C1ca horizon ranges from clay loam to clay in texture. Visible segregated calcium carbonate makes up less than 5 percent of any layer having its upper boundary within 40 inches of the surface. The electrical conductivity of the saturated soil extract ranges from 2 to 15 millimhos per centimeter at a depth below 30 inches.

Garceno clay loam (Ga).—Areas of this soil are nearly level, irregularly shaped, and as much as several hundred acres in size. This soil is high in content of lime and is droughty. The surface crusts easily, and consequently, the rate of water intake is reduced.

Included in mapping were spots of Copita fine sandy loam, which are in slightly higher positions on the landscape, and a few narrow areas of Montell clay, saline, which occurs in lower positions. Also included were narrow stream channels and a few gullied spots.

Most of the acreage is used for range. The control of water erosion is not a problem, but some sheet erosion has occurred in places where the natural vegetation has been removed by overgrazing. Surface runoff is slow. (Capability units VIc-2, nonirrigated, and I-3, irrigated; Clay Loam range site)

Grulla Series

The Grulla series consists of deep, somewhat poorly drained, level to slightly depressed soils on flood plains along the Rio Grande and its major tributaries. These soils are in old, partly filled resacas or abandoned stream channels. Unless artificial drainage has been provided, water remains on the surface in the depressed areas for periods ranging from several weeks to several months after heavy rains.

In a representative profile the surface layer is grayish-brown clay about 7 inches thick. The underlying material, to a depth of about 65 inches, is grayish-brown, very firm clay that contains bedding planes and lenses or strata of more loamy material.

Internal drainage and permeability are very slow, and the available water capacity is high.

About 60 percent of the acreage is used for range, but the use of about 40 percent of the acreage is divided about equally between irrigated crops and nonirrigated crops. A few areas are idle.

Representative profile of Grulla clay, 8.5 miles north, 77° west of Rio Grande City, in a cultivated field, 200 feet east of unimproved road, and 2,700 feet south of intersection of U.S. Highway 83 and Farm Road 649, at Garceno.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; weak granular structure; extremely hard when dry, very firm when moist; few roots; few earthworm casts; the uppermost one-half inch is lighter colored (10YR 6/2) and consists of recently waterlaid sediments of clay texture; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 20 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; the surfaces of some clay fragments have few, distinct, coarse mottles of reddish brown (5YR 4/4) when moist; massive; very hard when dry, very firm when moist, sticky and plastic when wet; very few pores; clay fragments of variable size but mainly about 2 inches across the axis (interfaces are dull, not shiny); distinct horizontal cleavage planes; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—20 to 37 inches, grayish-brown (10YR 5/2) clay and a few lenses and pockets of clay loam and loam; dark grayish brown (10YR 4/2) when moist; few yellowish-brown mottles; massive; very hard when dry, very firm when moist, sticky and plastic when wet; few horizontal cleavage planes; pressure faces have shiny surfaces; calcareous; moderately alkaline; wavy, diffuse boundary.

C3—37 to 65 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; massive; few partings in only slightly altered sediments; very hard when dry, very firm when moist, sticky and plastic when wet; bedding planes are evident; calcareous, moderately alkaline.

When dry, these soils have cracks ranging from 1 to 10 centimeters in width to a depth of at least 20 inches. Salinity ranges from none to moderate. The Ap and C horizons range from grayish brown to brown or pale brown in color.

Grulla clay (Gr).—Areas of this soil are mainly elongated and 15 to more than 200 acres in size. Flooding occurs about twice in 5 years. The slopes are level to slightly concave; the gradient is less than 1 percent. This soil has the profile described as representative of the series.

Included in mapping were spots of Matamoros silty clay, which occurs in slightly higher positions on the landscape, and spots of Grulla clay, depressional, which occur in lower concave positions.

Most of the acreage is in range, but some is cultivated (fig. 12). Both nonirrigated and irrigated crops are grown. The soil is difficult to work. Some crops and grasses can be grown where surface drainage is provided and other proper management measures are used. Surface runoff is very slow to ponded. (Capability units IVw-1, nonirrigated, and IIIw-1, irrigated; Bottomland range site)

Figure 12.—Cultivated field of Grulla clay.

Grulla clay, depressional (Gu).—This soil occurs mainly as elongated areas that range from about 10 to 150 acres in size. It is on the active flood plains of the Rio Grande and in the beds or floors of resacas or abandoned stream channels. Almost every year it is either flooded by the Rio Grande and its tributaries, or it receives runoff from surrounding areas. The slopes are concave; the gradient is less than 1 percent.

Typically, the surface layer is light brownish-gray calcareous clay about 8 inches thick. Below this, to a depth of 40 inches, is brown, very firm and very plastic, calcareous clay that has little structure. This layer has a few distinct mottles of reddish brown and yellowish brown, mainly on the faces of the fractures of bedding planes and in old root channels. The underlying calcareous, clayey sediments are brown and are stratified with loamy sediments.

Included in mapping were spots of Grulla clay, which occurs at slightly higher elevations, and a few areas of Matamoros silty clay, which is more nearly level and occurs at slightly higher elevations.

Most of the acreage is in native vegetation, but some areas are cultivated and irrigated. The control of wetness is a problem in cultivated areas. Some areas remain wet several months each year, and in years when rainfall is above average, water stands on the surface for periods of more than 3 months. If surface drainage is provided and the soil is properly managed, a few crops and grasses can be grown. This soil is difficult to work. Surface runoff is ponded. (Capability units Vw-1, nonirrigated, and Vw-1, irrigated; Bottomland range site)

Jimenez Series

The Jimenez series consists of excessively drained, undulating to hilly, very gravelly soils that are shallow over caliche. These soils are on high terraces and ridges along the Rio Grande. They have a high content of lime. The slope range is 3 to 20 percent.

In a representative profile the surface layer, about 10 inches thick, is brown very gravelly loam. About 60 to 70 percent, by volume, of this layer is rounded siliceous gravel. The underlying material, to a depth of 20 inches, is caliche that is strongly cemented in the uppermost 2 inches and weakly cemented below.

Internal drainage is medium, permeability above the caliche is moderately rapid, and the available water capacity is low.

Jimenez soils are used for range.

Representative profile of Jimenez very gravelly loam, in an area of Jimenez-Quemado association, 50 feet west of a county road, 0.5 mile north of U.S. Highway 83 at Escobares.

A1—0 to 10 inches, brown (7.5YR 5/2) very gravelly loam, dark brown (7.5YR 3/2) when moist; weak granular structure; slightly hard when dry, friable when moist; many fine and very fine pores; 60 to 70 percent, by volume, is rounded siliceous gravel mostly less than 5 centimeters in diameter; many pebbles have thin coatings of calcium carbonate; calcareous; moderately alkaline; abrupt, wavy boundary.

C1cam—10 to 12 inches, white (10YR 8/2), strongly cemented caliche; about 30 percent of the mass consists of embedded siliceous gravel; the upper surface is smooth, is finely laminated, and has a hardness of 3 on the Mohs scale, when dry; clear, irregular boundary.

C2—12 to 20 inches, white (10YR 8/2), weakly cemented, massive caliche; about 75 percent, by volume, is embedded, rounded, siliceous gravel.

The A horizon ranges from 5 to 15 inches in thickness, from grayish brown to brown in color, and from very gravelly loam to very gravelly fine sandy loam in texture. The amount of gravel in the solum ranges from 50 to 75 percent, by volume. The laminar upper surface of the C1cam horizon ranges from 14 inch to 2 inches in thickness. Cementation ranges from moderate to strong. The caliche ranges from 3 to more than 15 feet in thickness.

Jimenez-Quemado association (Jq).—Areas of this association are broad, dissected, irregularly shaped, and as much as 500 acres in size. They are on high terraces 20 to 50 feet above the flood plains along the Rio Grande. In most areas the Jimenez soils occupy the slope breaks extending from the top of the ridge to the bottom of the slope and the narrow valleys between the ridges. Quemado soils occur as narrow areas on the ridgetops. The slopes are convex; the slope range is 3 to 20 percent.

Jimenez soils make up about 52 percent of the acreage, the Quemado soils make up about 38 percent, and included soils make up the rest. The Jimenez and Quemado soils are shallow, undulating to hilly, and very gravelly loams or fine sandy loams and are underlain by strongly cemented caliche. The Jimenez soils contain free lime, but the Quemado soils do not. These soils have the profile (fig. 13) described as representative of their respective series.

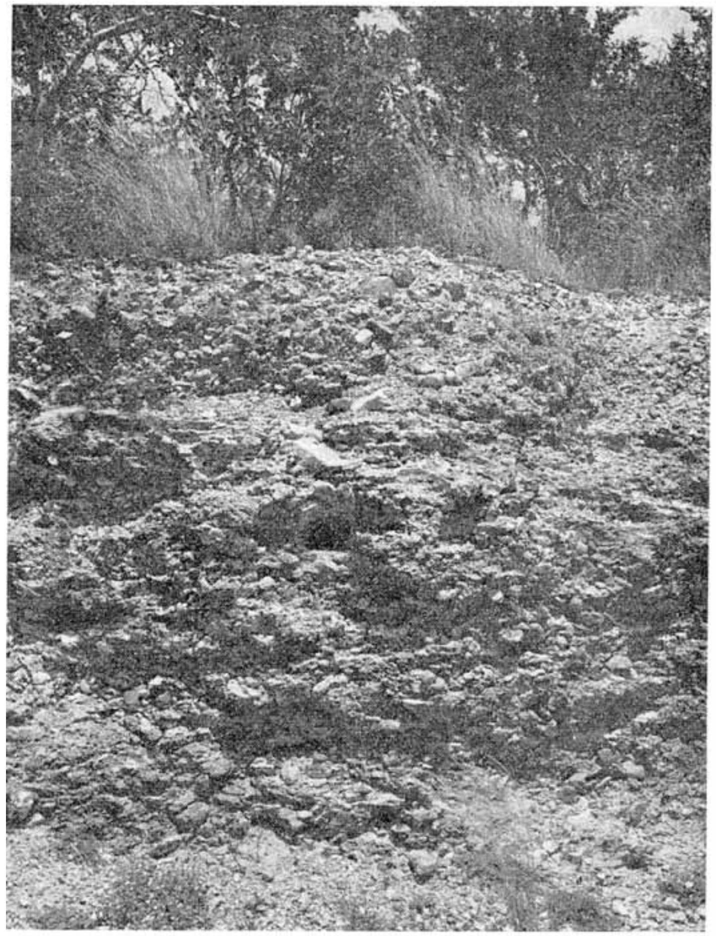

Figure 13.—Profile of Jimenez very gravelly loam.

Included in mapping were areas of Ramadero loam in the narrow valleys, a few spots of McAllen and Brennan soils, and a few areas of outwash sediments in some of the narrow valleys. Also included were some steep escarpments and rock outcrops, which are adjacent to the flood plains of the Rio Grande.

The entire acreage is used for range. Runoff is rapid, and erosion is a slight hazard. Gravel is mined commercially in some areas. Several hundred acres have been partly stripped or otherwise disturbed in the operation of gravel pits. (Capability unit VIIs-2, nonirrigated; Gravelly Ridge range site)

Lagloria Series

The Lagloria series consists of deep, well-drained, nearly level soils on old flood plains or terraces that no longer receive sediments from flooding. These soils developed in loamy calcareous sediments. The slope is less than 2 percent.

In a representative profile the surface layer is light brownish-gray silt loam about 15 inches thick. The next layer, about 30 inches thick, consists of light brownish-gray, friable silt loam and threads and films of calcium carbonate. The underlying material, to a depth of about 78 inches, consists of light brownish-gray silt loam and thin strata of silty clay loam and very fine sandy loam.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Lagloria soils are mainly cultivated and irrigated, but a few areas either are dryfarmed or are idle. Where irrigated, these soils are well suited to crops, but in dryfarmed areas the choice of suitable crops is limited.

Representative profile of Lagloria silt loam, 50 feet south of U.S. Highway 83, from a point 3.3 miles east of its intersection with Farm Road 755 in Rio Grande City.

Ap—0 to 6 inches, light brownish-gray (10YR 6/2) silt loam. dark grayish brown (10YR 4/2) when moist; massive; hard when dry, friable when moist; porous; few worm casts; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

A1—6 to 15 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; porous; few worm casts and decaying roots; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

B2—15 to 45 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure, but stronger structure than in the A1 horizon; hard when dry, friable when moist; many fine pores and root channels; few streaks of brownish organic material; few mica flakes; threads and films of calcium carbonate in lower part; calcareous; moderately alkaline; gradual, wavy boundary.

C—45 to 78 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; thin strata of silty clay loam and very fine sandy loam; structureless; hard when dry, very friable when moist; porous; calcareous; moderately alkaline.

The A horizon ranges from 8 to 18 inches in thickness and from light brownish gray to pale brown in color. The B2 horizon ranges from 25 to 40 inches in thickness and from light brownish gray to pale brown in color. At depths between 10 to 40 inches, the soil material ranges from silt loam to very fine sandy loam in texture. In some profiles there is weak stratification of very fine sandy loam and silty clay loam. In some profiles there are slightly darker colored layers at a depth between 20 to 40 inches. These layers are old buried A horizons.

Lagloria silt loam (La).—Areas of this soil are broad, irregularly shaped, and generally several hundred acres in size. The slope is dominantly less than 1 percent, but it is as much as 2 percent in places.

Included in mapping were spots of Reynosa silty clay loam, generally in slightly lower positions on the landscape, and areas of Rio Grande silt loam in areas transitional to the active flood plain.

Almost all the acreage is cultivated and irrigated, and a variety of crops do well. The soil is easy to work, and the response to management is good. A few fields are not irrigated, but dryfarming is risky because the low, erratically distributed rainfall is not favorable. Surface runoff is slow. (Capability units IIIc-3, nonirrigated, and I-2, irrigated; Loamy Bottomland range site)

McAllen Series

The McAllen series consists of deep, well-drained, nearly level to gently sloping soils on uplands. These soils developed in friable loamy sediments that are high in content of lime. The slopes are convex, and the gradient is less than 3 percent.

In a representative profile (fig. 14) the surface layer is light brownish-gray fine sandy loam about 17 inches thick. The next layer is pale-brown friable sandy clay loam about 13 inches thick. The underlying material, to a depth of about 60 inches, is very pale brown sandy clay loam. This layer is about 15 percent concretions and lumps of calcium carbonate in the upper part and about 25 to 35 percent in the lower part.

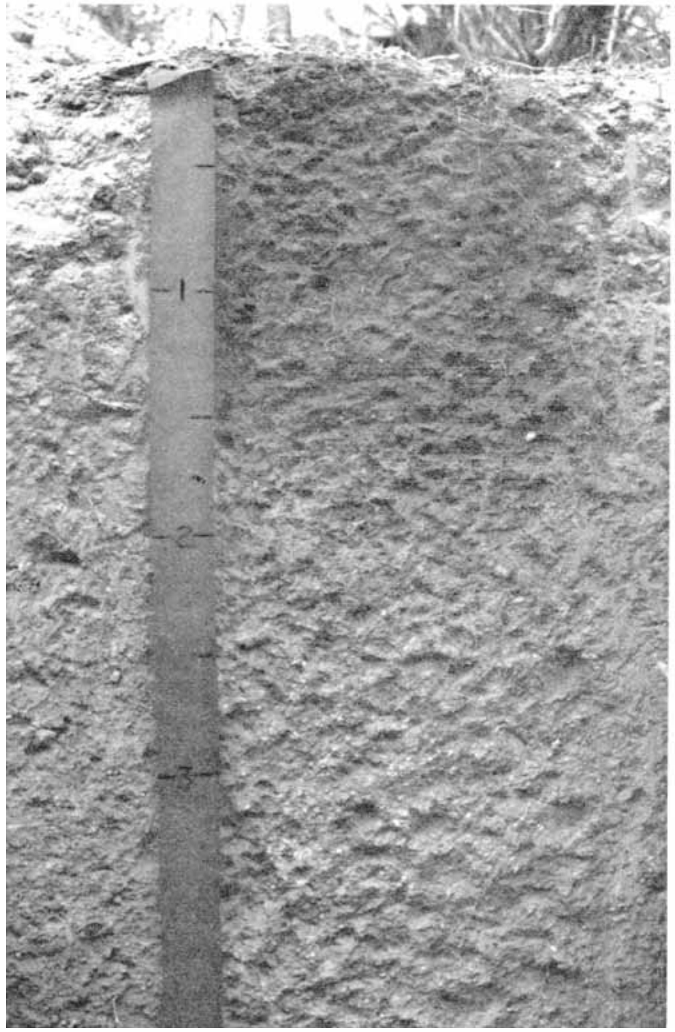

Figure 14.—Profile of McAllen fine sandy loam.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

McAllen soils are used mainly for range, a few acres are dryfarmed, and a limited acreage is irrigated. Some fields that were formerly cultivated have been seeded to grasses and used for pasture.

Representative profile of McAllen fine sandy loam, 150 feet northeast of the county road, 400 feet west of the intersection with Farm Road 755. This intersection is 7.0 miles north of Rio Grande City.

A11—0 to 7 inches, light brownish-gray (10YR 6/2) fine sandy loam; dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; porous; few broken snail shells; calcareous; moderately alkaline; gradual, wavy boundary.

A12—7 to 17 inches, light brownish-gray (10YR 6/2) fine sandy loam; dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; numerous roots; many fine pores; few broken snail shells; calcareous; moderately alkaline; gradual, wavy boundary.

B2—17 to 30 inches, pale-brown (10YR 6/3) sandy clay loam; brown (10YR 4/3) when moist; weak subangular blocky structure; slightly hard when dry, friable when moist; many fine pores and root channels; few broken snail shells; few films and threads of calcium carbonate; calcareous; moderately alkaline; diffuse, irregular boundary.

Cca—30 to 60 inches, very pale brown (10YR 7/4) sandy clay loam; yellowish brown (10YR 5/4) when moist; structureless; slightly hard when dry, friable when moist; many fine pores; few broken snail shells; the amount of strongly cemented concretions, soft lumps, and finely disseminated calcium carbonate ranges from an estimated 15 percent, by volume, in the upper part to 35 percent in the lower part; few, rounded, quartzite pebbles; calcareous.

The A horizon ranges from 12 to 19 inches in thickness and from grayish brown to light brownish gray or pale brown in color. The B horizon ranges from 10 to 25 inches in thickness, from grayish brown to pale brown in color, and from fine sandy loam to sandy clay loam in texture.

McAllen fine sandy loam (Mc).—Areas of this soil are broad, irregularly shaped, and as much as several hundred acres in size. The slope is dominantly less than 1 percent, but the slope range is 0 to 3 percent.

Included in mapping were areas, as much as 50 acres in size, of soils that vary slightly in color and lime content and are free of lime in the uppermost 6 to 8 inches. Also included were areas of Brennan fine sandy loam; a few areas of Ramadero loam, which occur as long narrow strips along drainageways; and spots of Zapata soils, which occur on rounded to elongated ridges.

Most of the acreage is used for range, but a few areas are dryfarmed. Dryfarming is risky because the low erratic rainfall is not favorable. The soil is suited to irrigation and can be revegetated to grasses. Crops respond to good management. Surface runoff is slow. (Capability units IVe-3, nonirrigated, and IIe-2, irrigated; Gray Sandy Loam range site)

Matamoros Series

The Matamoros series consists of deep, moderately well drained, nearly level to slightly concave soils on the active part of the flood plain along the Rio Grande and the alluvial fans of its major tributaries. These soils formed in recently deposited, firm, stratified clayey sediments that have a high content of lime. They are infrequently flooded. The slope is less than 1 percent.

In a representative profile the surface layer is light brownish-gray silty clay about 10 inches thick. The underlying material, to a depth of 29 inches, consists of light brownish-gray, firm silty clay and thin strata of silty clay loam and silt loam. Below this, to a depth of about 63 inches, it consists of light brownish-gray, stratified silty clay, silty clay loam, and silt loam.

Internal drainage and permeability are slow, and the available water capacity is high.

Matamoros soils are well suited to and are used mainly for irrigated crops.

Representative profile of Matamoros silty clay, 100 feet west of a field road approximately 0.25 mile southwest of the headquarters of La Casita Farms, 1.0 mile south of Garciasville.

Ap—0 to 10 inches, light brownish-gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) when moist; structureless; very hard and cloddy when dry, firm when moist; calcareous; moderately alkaline; clear, smooth boundary.

C1—10 to 29 inches, light brownish-gray (10YR 6/2) silty clay, brown (10YR 4/3) when moist; structureless; very hard when dry, firm when moist; few fine pores and root channels; thin strata of silty clay loam, silt loam, and unaltered clayey sediments; bedding planes; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

C2—29 to 63 inches, light brownish-gray (2.5Y 6/2) stratified silty clay, silty clay loam, silt loam, and thin layers of slightly altered clayey sediments; dark grayish brown (2.5Y 4/2) when moist; structureless; hard when dry, firm when moist; bedding planes are strongly expressed; few mica flakes; few spots and streaks of oxidized organic matter that are dark yellowish brown; calcareous; moderately alkaline.

The A horizon ranges from 5 to 12 inches in thickness. The A and C horizons range from grayish brown to very pale brown in color. The C horizon, to a depth of 40 inches, ranges from silty clay to silty clay loam in texture and is stratified with thin layers of silt loam and clay. At a depth below 40 inches, it ranges from silty clay to silt loam in texture. Cleavage of the bedding planes is weakly to strongly expressed. Mottles on the faces of the bedding planes and in old root channels range from few to common in abundance and from brownish to yellowish in color.

Matamoros silty clay (Mm).—Areas of this soil are irregularly shaped and about 20 to 100 acres in size. Flooding occurs about 1 year in 10. The slopes are nearly level to slightly concave; the gradient is less than 1 percent.

Included in mapping were spots of Camargo silty clay loam and a few elongated areas of Grulla clay, which generally occur at a slightly lower position on the landscape.

Most of the acreage is cultivated and irrigated. Dry-farming is risky because of the low erratic rainfall. This soil commonly has a perched water table following heavy irrigation or heavy rainfall because the lower layers have contrasting textures. Surface runoff is slow to ponded because the topography is level to slightly depressed. (Capability units IIIs-1, nonirrigated, and IIs-1, irrigated; Bottomland range site)

Maverick Series

The Maverick series consists of moderately deep, somewhat excessively drained, undulating soils on uplands.

In a representative profile (fig. 15) the surface layer is light olive-brown clay about 6 inches thick. The next layer is light olive-brown very firm clay, about 11 inches thick, that has common salt threads. The underlying material consists of pale-yellow, firm clay about 8 inches thick. This layer is about 2 percent strongly cemented concretions and soft lumps of calcium carbonate. Below this, to a depth of 60 inches, are pale-olive, weathered shale and thin strata of gypsum crystals and calcium carbonate.

Internal drainage is slow, permeability is slow, and the available water capacity is moderate.

Maverick soils are used for range. They are not cultivated, because they contain salts and are limited in depth and because the climate is dry.

Representative profile of Maverick clay, in an area of Maverick soils, eroded, 100 feet west of Loma Blanca Road, 10.8 miles north of its intersection with U.S. Highway 83. This intersection is 4 miles north of Roma.

A1—0 to 6 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; few roots; few earthworm casts; ½ inch surface crust is light yellowish brown (2.5Y 6/4) when dry and has weak, platy structure; few broken marine shells; calcareous; moderately alkaline; gradual, wavy boundary.

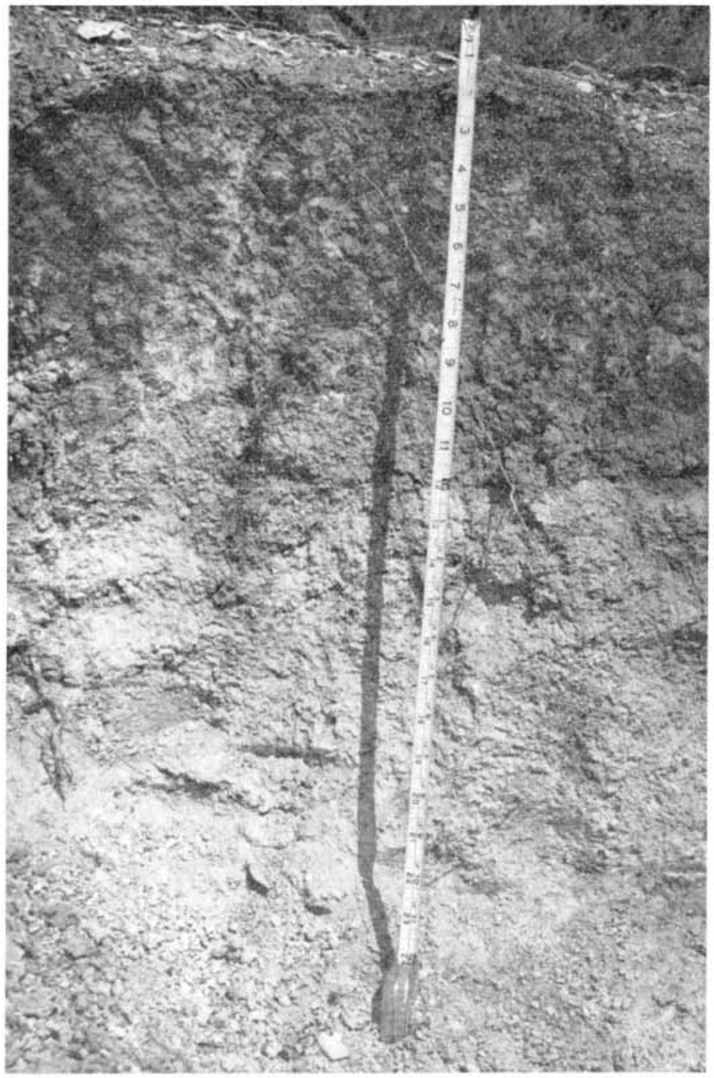

Figure 15.—Profile of Maverick clay.

B2—6 to 17 inches. light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; few fine pores; few shiny pressure faces on peds; common salt threads; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—17 to 25 inches, pale-yellow (5Y 7/3) clay, pale olive (5Y 6/3) when moist; few streaks and mottles of olive yellow and strong brown; weak, blocky structure hard when dry, firm when moist; about 2 percent, by volume, of strongly cemented concretions and soft lumps of calcium carbonate; few gypsum crystals; calcareous; moderately alkaline; gradual boundary.

R—25 to 60 inches, pale-olive (5Y 6/3), weathered shale; pale olive (5Y 6/3) when moist; few streaks and mottles of olive yellow; weak, blocky structure, mostly shale partings; thin strata containing crystals of gypsum and common soft lumps and strongly cemented concretions of calcium carbonate.

The A horizon ranges from 2 to 7 inches in thickness, from grayish brown to olive yellow in color, and from clay loam to clay in texture. The B2 horizon ranges from 10 to 18 inches in thickness and from light olive brown to yellow in color, and from clay to clay loam in texture. The saturated soil extract ranges from 4 to 14 millimhos per centimeter in conductivity, which generally increases with increasing depth. The Cca horizon is 1 to about 10 percent, by volume, visible calcium carbonate. Depth to the R layer ranges from about 20 to 35 inches. This layer consists of clayey shale and shale that contains bedding planes and some masses of calcium carbonate and layers of gypsum.

Maverick soils, eroded (Mu2).—Areas of this soil are undulating and irregularly shaped to elongated. They occupy the low ridges and valley walls and are dissected by many rills and gullies. The gullies are 2 to 6 feet deep and 20 to 50 feet wide, and some cannot be crossed with ordinary machinery. The original surface layer has been removed from about half the acreage, and the present surface layer is a mixture of materials from the subsoil and the substratum. The slopes are convex; the slope range is 1 to 5 percent.

Included in mapping were spots of Catarina soils and a few narrow areas of Zapata soils that generally occur on ridges. Also included were gullies, stream channels, and scour areas that have no vegetation.

The entire acreage is used for range (fig. 16). The control of erosion and revegetation to grasses are problems. The soil is droughty and hard to manage because it is clayey and saline and because water runs off rapidly. (Capability unit VIIe-1, nonirrigated; Rolling Hardland range site)

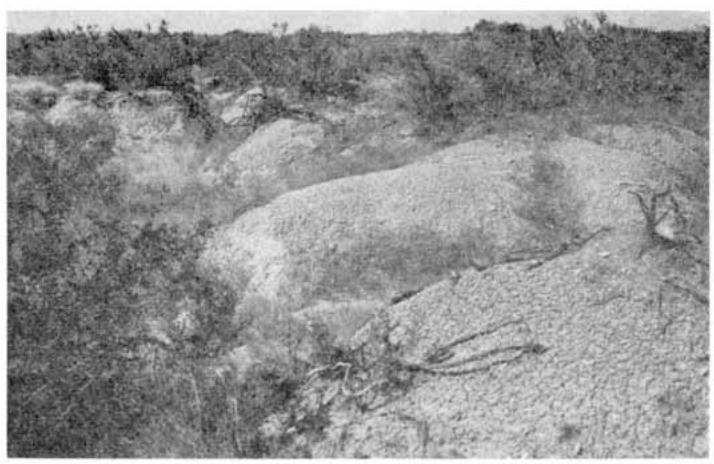

Figure 16.—Typical native vegetation on untreated Maverick soils, eroded.

Montell Series

The Montell series consists of deep, moderately well drained, nearly level, clayey soils on uplands. These soils developed in calcareous, gypsiferous, saline, clayey old alluvium or outwash. The slope is less than 2 percent.

In a representative profile (fig. 17) the surface layer is gray clay about 18 inches thick. The next layer is grayish-brown, very plastic, saline clay in the upper 7 inches and pale-brown, saline clay that contains a few threads of salt in the lower 13 inches. The underlying material, to a depth of about 63 inches, is pale-brown, saline clay that contains many threads and deposits of salts.

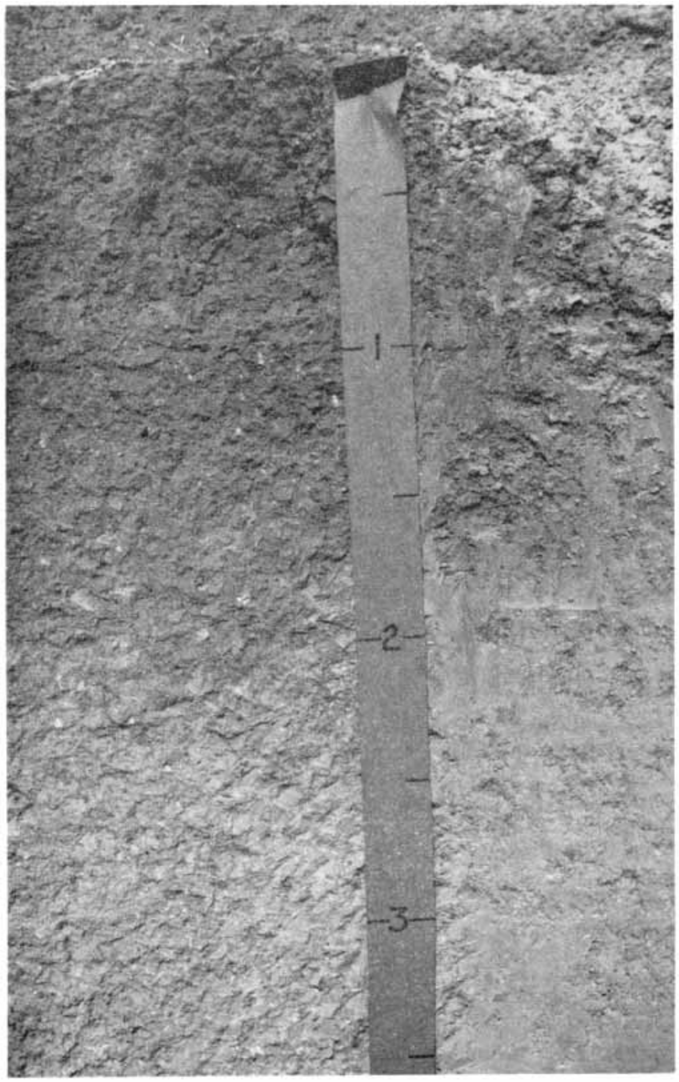

Figure 17.—Profile of Montell clay, saline.

Internal drainage and permeability are very slow. The soils are droughty; much of the soil water is not available to plants because of the salinity.

Montell soils are used for range. Response to management is slow because the soils are clayey and contain salts.

Representative profile of Montell clay, saline, 150 feet west of Loma Blanca Road, 12.2 miles north of U.S. Highway 83. This intersection is 4 miles north of Roma.

A11—0 to 11 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak, angular blocky structure; very hard when dry, very plastic when wet; few broken snail shells; about 5 percent of surface covered with rounded pebbles; calcareous; moderately alkaline; diffuse, smooth boundary.

A12—11 to 18 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; moderate, medium, angular blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; few roots; few very fine pores and root channels; wedge-shaped peds having their long axis tilted about 30° from the horizontal; peds have shiny pressure faces; calcareous; moderately alkaline; gradual, smooth boundary.

AC1—18 to 25 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, angular blocky structure; very hard when dry, very plastic when wet; few very fine pores; wedge-shaped peds that have their lung axis tilted about 30° from the horizontal; peds have shiny pressure faces; distinct, grooved slickensides that intersect; few threads of salts; saline; calcareous; moderately alkaline; diffuse, smooth boundary.

AC2—25 to 38 inches, pale-brown (10YR 6/3) clay, brown (10YR 5/3) when moist; weak, angular blocky structure; very hard when dry, firm when moist, plastic when wet; few burrows or root channels; wedge-shaped peds that have their long axis tilted about 30° from the horizontal; distinct grooved slickensides that intersect; few threads of salts; saline; calcareous; moderately alkaline; clear, smooth boundary.

C1sa—38 to 50 inches, pale-brown (10YR 6/3) clay, brown (10YR 5/3) when moist; weak, angular blocky structure; firm when moist, plastic when wet; very few fine pores; evidence of old root channels or animal burrows; about 10 percent by volume, of visible deposits of salts; distinct slickensides that intersect; saline; calcareous; moderately alkaline; diffuse, smooth boundary.

C2sa—50 to 63 inches, pale-brown (10YR 6/3) day, brown (10YR 5/3) when moist; weak, angular blocky structure; firm when moist, plastic when wet; few fine pores; many threads and deposits of salts; few gypsum crystals; few slickensides; saline; calcareous; moderately alkaline.

The A horizon ranges from 15 to 24 inches in thickness and from gray to dark gray in color. The AC horizon ranges from 14 to 20 inches in thickness and from grayish brown to light brownish gray in color. Intersecting slickensides begin at a depth of 18 to 30 inches. Depth to the C horizon ranges from 36 to 44 inches. All horizons are slightly to strongly affected by salinity. There is 15 to more than 40 percent exchangeable sodium in some horizons within 30 inches of the surface. Less than 2 percent ranging to about 25 percent of the surface is covered with rounded pebbles.

Montell clay, saline (Mt).—Areas of this soil are elongated and occupy broad valley floors along drainageways of the uplands. The slope range is less than 1 to about 2 percent.

Included in mapping were areas of Viboras clay that occur in slightly higher areas and areas of soils that have a surface layer of clay loam, that are high in content of salts, and that are almost barren of vegetation.

This soil is used for range (fig. 18). This soil is droughty and difficult to manage because it is clayey and highly saline. Grasses respond to careful management. Runoff is very slow. (Capability unit VIIs–1; Saline Clay range site)

Pits

Pits (Pt) are in areas where gravel, clay, and caliche can be obtained. The gravel and clay pits are mainly in the Jimenez-Quemado association. Caliche pits occur in areas of Zapata and Delmita soils. Most of the acreage is not suitable for farming. Some of the abandoned areas could be reclaimed and used for limited grazing or wildlife habitat if they were smoothed and seeded to grasses or other suitable vegetation. (Not in a capability unit or range site)

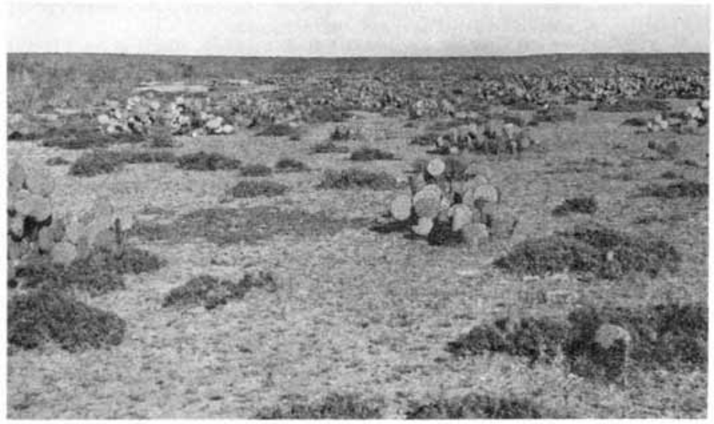

Figure 18.—Native vegetation on Montell clay, saline.

Quemado Series

The Quemado series consists of well-drained, undulating to hilly, very gravelly soils that are shallow over caliche. These soils are on terraces and ridges along the Rio Grande. The slope range is 2 to 20 percent.

In a representative profile (fig. 19) the surface layer, about 5 inches thick, is reddish-brown very gravelly loam that is about 50 percent gravel. The next layer, about 7 inches thick, is reddish-brown, friable, very gravelly loam that is about 55 percent gravel. The underlying material, to a depth of about 24 inches, consists of strongly cemented caliche and about 50 percent embedded gravel.

Internal drainage is medium, permeability above the layer of caliche is moderately rapid, and the available water capacity is low.

Quemado soils are used for range.

In Starr County, the Quemado soils are mapped only in an association with Jimenez soils.

Representative profile of Quemado very gravelly loam, in an area of Jimenez-Quemado association, 50 feet east of Farm Road 649 and 3,000 feet north of its intersection with U.S. Highway 83.

A1—0 to 5 inches, reddish-brown (5YR 5/3) very gravelly loam, dark reddish brown (5YR 3/3) when moist; weak granular structure; slightly hard when dry, friable when moist; 50 percent, by volume, of rounded quartz, chart, sandstone, and igneous gravel; neutral; clear, smooth boundary.

B2t—5 to 12 inches, reddish-brown (5YR 4/4) very gravelly loam, dark reddish brown (5YR 3/4) when moist; weak granular structure; slightly hard when dry, friable when moist; few thin clay films in pores; about 55 percent, by volume, of rounded gravel as in the A1 horizon; neutral; abrupt, smooth boundary.

Ccam—12 to 24 inches, pinkish-white (7.5YR 8/2), strongly cemented caliche having few fractures; finely laminated and indurated in the upper part; about 50 percent, by volume, of rounded siliceous gravel.

The A horizon ranges from 3 to 6 inches in thickness, from dark brown to brown or reddish brown in color, and from very gravelly loam to very gravelly fine sandy loam in texture. The amount of gravel in this horizon ranges from 50 to 75 percent, by volume. The Bt horizon ranges from 5 to 9 inches in thickness, from reddish brown to brown in color, and from loam to fine sandy loam in texture. Coarse, rounded pebbles of quartz, limestone, hard caliche, and igneous rocks make up 40 to 60 percent, by volume, of this layer. Reaction in the A and Bt horizons ranges from neutral to mildly alkaline. The C horizon ranges from moderately and strongly cemented in the upper part to weakly cemented in the lower part. The caliche in the lower part is massive. The pebbles on the surface are smooth and uncoated.

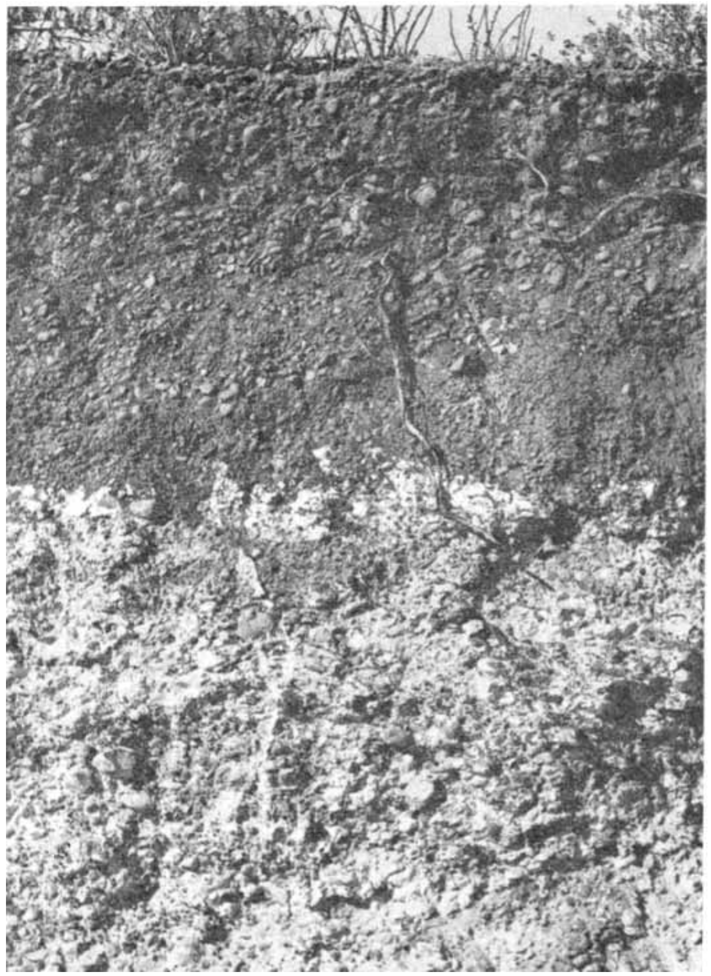

Figure 19.—Profile of Quemado very gravelly loam.

Ramadero Series

The Ramadero series consists of deep, well-drained, nearly level soils on uplands. These soils occupy long, narrow, shallow valleys that serve as drainageways. In most years they receive extra water and some fresh sediments because of their position on the landscape.

In a representative profile the surface layer is dark grayish-brown loam and sandy clay loam about 11 inches thick. The next layer is dark grayish-brown, friable sandy clay loam in the upper 11 inches; brown, firm sandy clay loam in the next 8 inches; and pale-brown, friable sandy clay loam in the lower 12 inches. Below this is a layer, about 26 inches thick, of pale-brown sandy clay loam and common threads, lumps, and concretions of calcium carbonate. The underlying material, to a depth of 80 inches, is light yellowish-brown sandy clay loam that contains calcium carbonate.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Ramadero soils are used mainly for range, but a few areas are dryfarmed.

Representative profile of Ramadero loam, 0.3 mile north of Farm Road 1561 and 5 miles east of its intersection with Farm Road 755. This intersection is 13.6 miles northeast of Rio Grande City.

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) loam of recent sediments, very dark grayish brown (10YR 3/2) when moist; weak subangular blocky structure; hard when dry, friable when moist; common fine pores; calcareous; mildly alkaline; clear, smooth boundary.
A12—4 to 11 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; weak prismatic structure breaking to subangular blocky; very hard when dry, friable when moist; many roots; common fine and medium pores; mildly alkaline; clear, smooth boundary.
B1t—11 to 22 inches, dark grayish-brown (10YR 4/2) sandy clay loam; dark brown (10YR 3/3) when moist: weak, very coarse, prismatic structure breaking to weak, subangular blocky; very hard when dry, friable when moist; common fine and medium pores; few clay films; few fine threads of calcium carbonate; moderately alkaline; diffuse, wavy boundary.
B2t—22 to 30 inches, brown (10YR 5/3) sandy clay Loam, brown (10YR 4/3) when moist; moderate, fine and medium, blocky structure; very hard when dry, firm when moist; common fine pores; few clay films; few threads of calcium carbonate; moderately alkaline; diffuse, wavy boundary.
B3t—30 to 42 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak subangular blocky structure; very hard when dry, friable when moist; common fine and medium pores; few threads of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.
C1ca—42 to 68 inches, pale-brown (10YR 6/3) sandy clay Loam, brown (10YR 5/3) when moist; weak subangular blocky structure; hard when dry, friable when moist; common fine and medium pores; common threads, soft lumps, and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.
C2—68 to 80 inches, light yellowish-brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; structureless; hard when dry, friable when moist; porous, few threads of segregated calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 8 to 14 inches in thickness and from dark grayish brown to brown in color. In places the A11 horizon is noncalcareous. The Bt horizon ranges from 21 to 38 inches in thickness, from dark grayish brown to pale brown in color, and from sandy clay loam to clay loam in texture. Depth to the Cca, horizon ranges from 36 to 48 inches. The amount of visible lime in this horizon ranges from 3 to 10 percent, by volume, and decreases as depth increases.

Ramadero loam (Ra).—Areas of this soil occur mainly as long, narrow areas in drainageways or on valley floors. They occur on low parts of the landscape throughout most of the uplands in the county. The slopes are concave; the gradient is dominantly less than 1 percent.

Included in mapping were areas of Brennan and McAllen soils. Also included were active creek channels less than 30 feet wide and small drainageways.

Most of the acreage is used for range, but a few small fields have been cleared and are used for cultivated crops. This soil is well suited to crop production in years when rainfall is normal, but the control of wetness is a problem in years when rainfall is higher than average. Surface runoff is slow. (Capability units IIc-1, nonirrigated, and I-4, irrigated; Ramadero range site)

Reynosa Series

The Reynosa series consists of deep, well-drained, nearly level soils on old flood plains or terraces that no longer receive sediments from flooding. These soils developed in loamy calcareous sediments. The landscape is smooth, and the slope is less than 2 percent.

In a representative profile (fig. 20) the surface layer is grayish-brown silty clay loam about 14 inches thick. The next layer, about 33 inches thick, is light brownish-gray, friable silty clay loam that contains common films and threads of calcium carbonate. The underlying material, to a depth of about 73 inches, is pale-brown silty clay loam that contains thin lenses of silt loam.

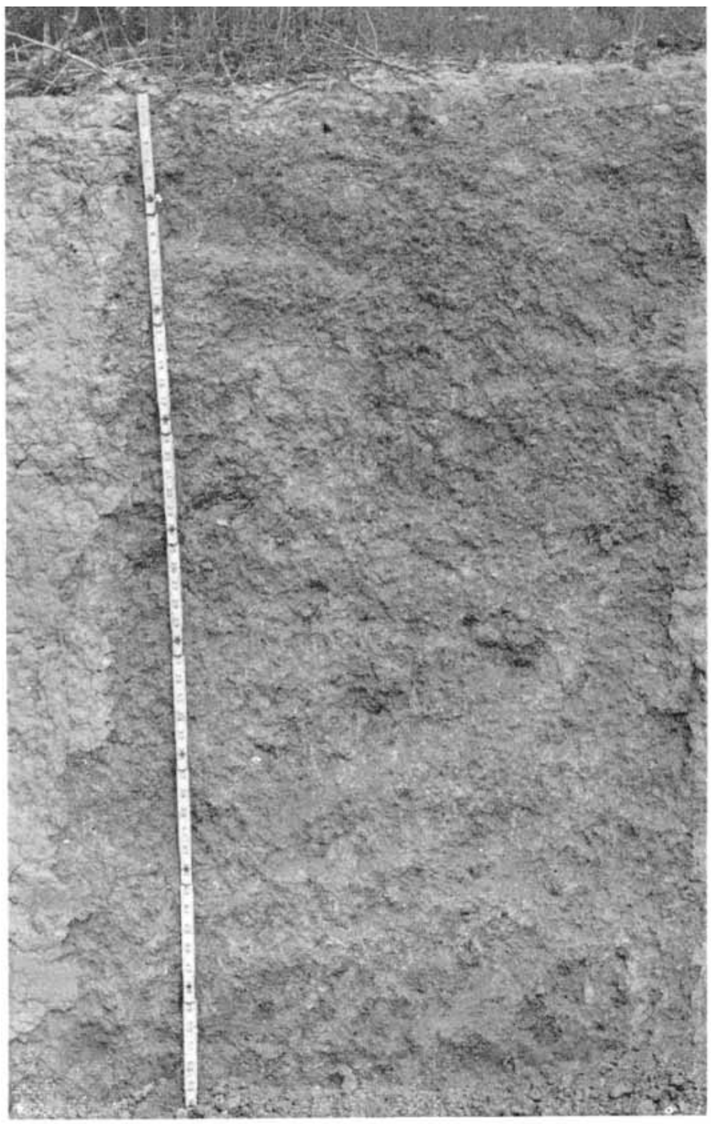

Figure 20.—Profile of Reynosa silty clay loam.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Reynosa soils are mainly cultivated, and a high proportion of the acreage is irrigated. A few small areas either are used for nonirrigated crops or are idle. If irrigated, these soils are well suited to a wide variety of crops.

Representative profile of Reynosa silty clay loam, in a field 100 feet east of a field road, from a point 2,400 feet north of its intersection with the main east-west road (or street) in Grulla. This intersection is 0.75 mile east of the terminal of Farm Road 2360.

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; massive; hard when dry, friable when moist; surface crust is lighter colored (10YR 6/2); few mica flakes; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—7 to 14 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; few worm casts; common fine pores; calcareous; moderately alkaline; diffuse, smooth boundary.

B2—14 to 47 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; common fine pores; common worm casts and spots of brownish colored, decaying organic material; common films and threads of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C—47 to 73 inches, pale-brown (10YR 6/3) silty clay loam and thin lenses of silt loam, brown (10YR 4/3) when moist; massive; hard when dry, friable when moist; calcareous; moderately alkaline.

The A horizon ranges from 12 to 17 inches in thickness and from grayish brown to pale brown in color. The B2 horizon ranges from 20 to 40 inches in thickness and from light brownish gray to pale brown in color. At depths between 10 and 40 inches the soil material ranges from silt loam to silty clay loam in texture. In places the C horizon has weakly stratified very fine sandy loam and silt loam.

Reynosa silty clay loam (Re).—Areas of this soil are broad, irregularly shaped, and generally several hundred acres in size. The slope is dominantly less than 1 percent, but it is as much as 2 percent in places.

Included in mapping were spots of Lagloria silt loam, which is generally at slightly higher elevations, and a few small elongated spots of Camargo silty clay loam, which is in areas that are transitional between the present flood plain and the terrace.

Almost all the acreage is cultivated and irrigated. This soil is easy to work. Surface runoff is slow. (Capability units IIIc-3, nonirrigated, and I-2, irrigated; Loamy Bottomland range site)

Rio Series

The Rio series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils occupy slightly depressed areas, a few inches below the level of adjacent soils and also occur as narrow bands or rings around small depressions. The slope is less than 1 percent.

In a representative profile the surface layer is gray sandy clay loam about 11 inches thick. The next layer is dark-gray to gray, firm sandy clay to sandy clay loam in the upper 23 inches and light brownish-gray, friable clay loam in the lower 22 inches. The underlying material, to a depth of about 63 inches, is light-gray clay loam. Lumps and concretions of calcium carbonate make up 3 percent, by volume, of this material.

Internal drainage and permeability are slow, and the available water capacity is high.

In Starr County, Rio soils are mapped only in a complex with Tiocano soils.

Representative profile of Rio sandy clay loam, in an area of Tiocano-Rio complex, 250 feet east of the north-south county road, 3.6 miles north of the intersection with Farm Road 490, and 3.2 miles east of Rincon.

A1—0 to 11 inches, gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) when moist; weak, granular structure; very hard when dry, friable when moist: the uppermost 2 inches consists of overwash of fine sandy loam; moderately alkaline; clear, smooth boundary.

B21t—11 to 23 inches, dark-gray (10YR 4/1) sandy clay, very dark gray (10YR 3/1) when moist; few, faint, dark reddish-brown mottles; moderate, fine, prismatic structure breaking to moderate, fine, blocky; very hard when dry, firm when moist; few fine pores; few thin clay films on ped surfaces and in pores; moderately alkaline; diffuse, smooth boundary.

B22t—23 to 34 inches, gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) when moist; few, faint, brown mottles; weak blocky structure; very hard when dry, firm when moist; few pores and roots; moderate'y alkaline; diffuse, smooth boundary.

B3—34 to 56 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak subangular blocky structure; hard when dry, friable when moist; few threads of calcium carbonate; moderately alkaline; diffuse, smooth boundary.

Cca—56 to 63 inches, light-gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) when moist; structureless; hard when dry, friable when moist; soft lumps and strongly cemented concretions of calcium carbonate make up about 3 percent, by volume, and increase in amount with increasing depth; calcareous; moderately alkaline.

The A horizon ranges from 8 to 14 inches in thickness and from very dark gray to grayish brown in color. The Bt horizon ranges from 18 to 27 inches in thickness, from very dark gray to grayish brown in color, and from sandy clay loam to clay in texture. Mottles range from faint to prominent in contrast and make up as much as 2 percent of the matrix. The depth to the Cca horizon ranges from 50 to 65 inches. The amount of lime in this horizon ranges from about 2 to 5 percent, by volume. In some places, there is as much as 5 inches of overwash sediments on the surface, but in other places, the overwash is lacking.

Rio Grande Series

The Rio Grande series consists of deep, well-drained, nearly level to gently sloping soils on the active part of the flood plain along the Rio Grande and on alluvial fans along its major tributaries. These soils are infrequently flooded. They formed in recently deposited, friable, stratified silty sediments that are high in content of lime. The slope range is 0 to 3 percent.

In a representative profile the surface layer is light brownish-gray silt loam about 7 inches thick. The underlying material, to a depth of 20 inches, is light brownish-gray, friable silt loam. Below this, to a depth of about 63 inches, it is pale-brown, very friable silt loam and thin strata of very fine sandy loam and silty clay loam.

Internal drainage is medium, permeability is moderate, and the available water capacity is high.

Rio Grande soils are well suited to crops and are used mainly for irrigated crops. A few areas are dryfarmed, but the low rainfall is a limitation to dryfarming in most years. A small acreage remains in range.

Representative profile of Rio Grande silt loam, 0 to 1 percent slopes, 1.25 miles south, 43° east of La Grulla, 50 feet east of a private road from a point that is 1.0 mile south of its intersection with the main east-west street in La Grulla.

Ap—0 to 7 inches, light gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; few mica flakes; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—7 to 20 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; few roots; few fine pores and worm casts; few mica flakes; few broken snail shells, bedding planes are evident; few dark yellowish-brown and strong-brown organic stains along bedding planes; calcareous; moderately alkaline; clear, smooth boundary.

C2—20 to 63 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) when moist; structureless; soft when dry, very friable when moist; few roots and root channels; few mica flakes; thin strata and lenses of very fine sandy loam and silty clay loam; many bedding planes; few root channels and bedding planes have brownish organic stains; calcareous; moderately alkaline.

The A horizon ranges from 5 to 8 inches in thickness, from light gray or light brownish gray to pale brown or very pale brown in color, and from silt loam to silty clay loam in texture. The C horizon ranges from light gray or light brownish gray to pale brown or very pale brown in color. Its texture ranges from silt loam to very fine sandy loam in the upper part, but at a depth below 40 inches, the sediments are stratified and the texture ranges from fine sandy loam to silty clay.

Rio Grande silt loam, 0 to 1 percent slopes (RgA).—Areas of this soil are broad, irregularly shaped, and several hundred acres in size. This soil is flooded about 1 year in 10. It has the profile described as representative of the series.

Included in mapping were spots of a soil that has a surface layer of silty clay loam, which is in slightly lower positions on the landscape, and a few spots of Matamoros silty clay, also in slightly lower areas. Also included were areas, where the slope is 1 to 3 percent, that occur on narrow, elongated natural levees and areas of Lagloria loam that occur at slightly higher elevations where flooding is rare.

Most of the acreage is cultivated and irrigated, but a few fields are dryfarmed. Dryfarming is risky because the low, erratic rainfall is unfavorable. Surface runoff is slow. (Capability units IIIc–2; nonirrigated, and I–2 irrigated; Loamy Bottomland range site)

Rio Grande silt loam, 1 to 3 percent slopes (RgB).—Areas of this soil are narrow, elongated in most places, and generally less than 200 acres in size. They occur on natural levees adjacent to resacas or escarpments within the flood plain along the Rio Grande. Flooding occurs about 1 year in 10. The slopes are convex.

The surface layer of this soil is light brownish-gray silt loam about 6 inches thick. Below the plow layer, to a depth of 25 inches, is light brownish-gray, friable, calcareous silt loam. Below this, to a depth of about 63 inches, is light brownish-gray, very friable very fine sandy loam and thin strata of silty clay loam and silt loam. Below the plow layer, bedding planes are evident.

Included in mapping were spots of Zalla loamy fine sand, which occur in slightly higher areas, a few areas where slopes are less than 1 percent, and areas of Lagloria silt loam, which occur at slightly higher elevations.

Most of the acreage is cultivated and irrigated, and a few areas are idle. Landforming operations are needed to develop an irrigation system. Surface runoff is medium. (Capability units IVe–4, nonirrigated, and IIe-4, irrigated; Loamy Bottomland range site)

Rio Grande silty clay loam (Rr).—This soil is nearly level. It occurs as irregularly shaped areas, mainly about 20 to about 200 acres in size. Flooding occurs about 1 year in 10. The slope is less than 1 percent.

Typically, the surface layer or plow layer is light brownish-gray, calcareous silty clay about 7 inches thick. Below the plow layer, to a depth of 50 inches, is light brownish-gray, friable, stratified silt loam, very fine sandy loam, and thin layers of silty clay loam. Very thin bedding planes are evident. The underlying sediments, to a depth of about 63 inches, are pale brown and are stratified with more clayey or loamy materials.

Included in mapping were spots of Rio Grande silt loam, which occur in slightly higher parts of the landscape, and a few areas of Matamoros silty clay, which occur at slightly lower elevations. Also included were areas of Lagloria silt loam.

Most of the acreage is cultivated and irrigated, but a few fields are dryfarmed. Dryfarming is risky because the low erratic rainfall is unfavorable. Surface runoff is slow. (Capability units IIIc–2, nonirrigated, and I-2, irrigated; Loamy Bottomland range site)

Sarita Series

The Sarita series consists of deep, well-drained, nearly level to gently undulating soils on uplands. When these soils are bare, they are highly susceptible to soil blowing. The slopes are convex; the gradient is less than 3 percent.

In a representative profile the surface layer is brown fine sand about 14 inches thick. The subsurface layer is pale-brown, very friable fine sand about 32 inches thick. The next layer extends to a depth of 75 inches or more. In the upper 18 inches it is brown, very firm sandy clay loam that has mottles of dark yellowish brown, strong brown, and red. Below this, it is pale-brown, very firm sandy clay loam that has a few yellowish and grayish mottles and a few soft lumps of calcium carbonate.

Permeability is moderate, and the available water capacity is low.

Sarita soils are used for range. They are difficult to revegetate.

Representative profile of Sarita fine sand, 3 miles north of Farm Road 1017 on a private road that is 3.5 miles east of the San Isidro School.

A1—0 to 14 inches, brown (10YR 5/3) fine sand, dark brown (10YR 4/3) when moist; structureless; loose; numerous fine roots; neutral; gradual, smooth boundary.

A2—14 to 64 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 4/3) when moist; structureless; very friable; few roots; neutral; abrupt, smooth boundary.

B21t—46 to 64 inches, brown (10YR 5/3) sandy clay loam; dark brown (10YR 4/3) when moist; few, fine and medium, faint mottles of dark yellowish brown and strong brown, and few distinct mottles of red; moderate, coarse, prismatic structure and weak blocky structure; extremely hard when dry, very firm when moist; few pores; continuous coatings on prism faces; neutral; gradual boundary.

B22t—64 to 75 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; few, faint, yellowish and grayish mottles; weak blocky structure; extremely hard when dry, very firm when moist; few soft lumps of calcium carbonate in lower part; calcareous; moderately alkaline.

The A horizon ranges from 40 to 60 inches in thickness. The A1 horizon ranges from grayish brown to yellowish brown in color, and the A2 horizon ranges from pale brown to light yellowish brown. The Bt horizon ranges from brown and pale brown to reddish yellow in color and from fine sandy loam to sandy clay loam in texture. It ranges from few to many in number of yellowish and reddish mottles, and in places it has a few grayish mottles. The solum ranges from about 60 to 90 inches in thickness.

Sarita fine sand (Sa).—Areas of this soil are irregularly shaped, smooth to mounded or dunelike in appearance, and rather large or as much as several hundred acres in size. The slope range is 0 to 3 percent.

Included in mapping were areas of soils that have less than 40 inches of fine sand over more clayey material. Also included were spots of Falfurrias fine sand, which occupies mounds or low stabilized dunes.

This soil is used mainly for range. Plant response to small amounts of water received as rainfall is good. When it is bare of vegetation, this soil is susceptible to severe soil blowing. Dryfarming is risky. Runoff is slow to very slow. (Capability units VIe-1, nonirrigated, and IIIs-2, irrigated; Deep Sand range site)

Tiocano Series

The Tiocano series consists of deep, somewhat poorly drained, nearly level, clayey soils in upland depressions. These soils are ponded. They developed in calcareous, clayey sediments that had been deposited in the depressions or lagunas.

In a representative profile the surface layer is dark-gray clay about 32 inches thick. The next layer is gray, very firm clay about 18 inches thick. This layer has many wedge-shaped blocks that have shiny surfaces. The underlying material, to a depth of about 66 inches, is light brownish-gray clay that contains a few soft lumps and concretions of calcium carbonate.

Internal drainage and permeability are very slow, and the available water capacity is high.

Tiocano soils are used for range. They are saturated or covered with water about half the time during the growing season.

In Starr County Tiocano soils are mapped only in a complex with Rio soils.

Representative profile of Tiocano clay, in an area of Tiocano-Rio complex, 22 miles north, 50° east of Rio Grande City, 125 feet east of a county road and 3.6 miles north of its intersection with Farm Road 490. This inter-section is 9.6 miles west of the Starr-Hidalgo county line.

A11—0 to 10 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; few fine mottles of reddish brown along old root channels; moderate, fine, blocky structure; when dry, the uppermost 2 inches is very hard and has very fine and fine, granular structure; very firm when moist, very sticky and plastic when wet; few roots; few insect burrows; moderately alkaline; gradual, irregular boundary.

A12—10 to 32 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; few fine mottles of reddish brown in upper part; moderate, medium and coarse, blocky structure; very hard when dry, very firm when moist; few roots; wedge-shaped peds have long axis tilted about 25° from the horizontal, and peds have shiny faces; distinct slickensides; moderately alkaline; diffuse, irregular boundary.

AC—32 to 50 inches, gray (10YR 5/1) clay; dark gray (10YR 4/1) when moist; very hard when dry, very firm when moist; many distinct wedge-shaped peds with their axis tilted about 25° to 45° from the horizontal; peds have shiny faces; distinct slickensides; few dark-gray streaks along the old cracks; calcareous; moderately alkaline; diffuse, irregular boundary.

C—50 to 66 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) when moist; structureless; massive; very hard when dry, very firm when moist; few concretions and soft lumps of calcium carbonate; calcareous; moderately alkaline.

The thickness of the A horizon ranges from 12 inches in the center of the microknolls to about 40 inches in the center of the microdepressions, and the color ranges from dark gray to very dark gray. The thickness of the AC horizon ranges from about 10 inches in the microdepressions to 24 inches in the microknolls. Depth to the C horizon ranges from 40 to 60 inches. This soil has cracks that range from 0.5 inches to more than 2 inches in width and, when the soil is dry, from 30 to 40 inches in depth.

Tiocano-Rio complex (Tr).—These soils are nearly level. They occur in such an intricate pattern that it is not feasible to map them separately. They occupy concave depressions and lagunas (fig. 21). Tiocano clay occurs in the center or lowest part of the depressions; Rio sandy clay loam occurs as narrow bands on the outer ring of depressions and lagunas. The Tiocano soil makes up about 55 to 65 percent of this complex, the Rio soil makes up about 20 to 30 percent, and other soils make up the remaining 10 to 15 percent. Areas of these soils are mainly oval, but a few areas are elongated. They range from 5 to 30 acres in size. The slope is less than 1 percent. Included in mapping were a few elongated areas of Ramadero loam.

Figure 21.—Aerial view of a typical depression in which soils of the Tiocano-Rio complex occur. The darker colored area is the depression.

These soils are used mainly for range, but a few have been cleared and are farmed. These soils receive extra moisture as runoff from surrounding soils, and the native vegetation is often killed by the wetness. These soils are suitable for crop production in years when rainfall is normal or below normal. Runoff is ponded. (Capability unit Vw-1, nonirrigated; Laguna range site)

Viboras Series

The Viboras series consists of moderately deep, well-drained, nearly level, saline, clayey soils on uplands. These soils occupy broad, shallow valleys, outwash plains, or basins. The slope is less than 1 percent.

In a representative profile the surface layer is reddish-brown clay about 5 inches thick. Most of this layer is saline and has a few threads of salts. The next layer, about 29 inches thick, is reddish-brown, very firm, saline clay that has a few threads of salt and films of calcium carbonate. Below this, to a depth of about 63 inches, is pinkish-gray, saline, clayey shale.

Internal drainage and permeability are very slow. The available water capacity is high, but the water available to plants is restricted because of the salinity.

Viboras soils are used only for range. Stands of native vegetation are sparse because the soil has clayey texture and a high content of salts.

Representative profile of Viboras clay, about 1.5 miles west of Loma Blanca road, 14 miles north of the intersection of Loma Blanca road with U.S. Highway 83. This intersection is 4 miles north of Roma.

A11—0 to 2 inches, reddish-brown (5YR 5/3) clay, reddish brown (5YR 4/3) when moist; moderate, very fine, granular structure; very hard when dry, very firm moist; few round quartzite pebbles on the surface; calcareous; moderately alkaline; clear, smooth boundary.

A12—2 to 5 inches, reddish-brown (5YR 5/3) clay, reddish brown (5YR 4/3) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; few roots; few salt threads; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B2—5 to 25 inches, reddish-brown (5YR 5/3) clay, reddish brown (5YR 4/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; few salt threads; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—25 to 34 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; few faint mottles of gray and reddish brown; weak angular blocky structure: very hard when dry, very firm when moist; few parallelepipeds; few slickensides; few salt threads and films of calcium carbonate: saline; calcareous: moderately alkaline; gradual, irregular boundary.

C—34 to 63 inches, pinkish-gray (5YR 6/2) clayey shale, dark reddish gray (5YR 4/2) when moist; massive; very hard when dry; saline; calcareous; moderately alkaline.

These soils have cracks ranging from 0.5 inch to more than 2 inches in width and, when the soils are dry, from more than 20 to 30 inches in depth. The A horizon ranges from reddish gray to reddish brown or brown in color. The B3ca horizon has about the same colors as the B2 horizon, but the colors are about 1 value or 1 chroma higher. Salinity is slight to strong in the uppermost 25 inches and strong at a depth below 25 inches.

Viboras clay (Vc).—Areas of this soil are irregularly shaped and between 200 and 600 acres in size. They occur in shallow valleys, outwash plains, or basins of the uplands. Included in mapping were spots of Montell clay, saline, and a few areas of gently sloping Catarina soils, which are on low ridges.

The entire acreage is used for range. Revegetation of native and introduced grasses is a problem. This soil is droughty and difficult to manage because it is clayey and saline. Surface runoff is very slow. (Capability unit VIIs-1, nonirrigated; Saline Clay range site)

Zalla Series

The Zalla series consists of deep, somewhat excessively drained, gently sloping to hummocky soils on the active part of flood plains along the Rio Grande. These soils formed in recent deposits of loose, calcareous, stratified sands. They are flooded frequently or about 1 year in 5, but they are not flooded at regular intervals.

In a representative profile the surface layer is pale-brown loamy fine sand about 3 inches thick. The underlying material, to a depth of about 63 inches, is very pale brown, loose loamy fine sand that contains thin strata of silt loam and very fine sandy loam.

Internal drainage and permeability are rapid, and the available water capacity is low.

Zalla soils are generally idle. They are not suitable for cultivation, because they are sandy, have rough surfaces, and are flooded frequently.

Representative profile of Zalla loamy fine sand, 9 miles south, 40° east of Rio Grande City; in a large bend of the Rio Grande, and 4 3/4 miles south of Garciasville along a private road.

A1—0 to 3 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist, structureless; loose when dry, very friable when moist, nonsticky when wet; many fine roots; calcareous; moderately alkaline; clear, smooth boundary.

C—3 to 63 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) when moist; structureless; loose; few lenses and thin strata of silt loam and very fine sandy loam 2 millimeters to 2 centimeters thick; bedding planes are evident, especially where the thin strata of silt loam or very fine sandy loam are in contact with loamy fine sand; few organic stains at the contact of the horizontal bedding planes; few mica flakes; calcareous; moderately alkaline.

The A horizon ranges from pale brown to light brownish gray. At depths between 10 and 40 inches the soil material ranges from light brownish gray to very pale brown in color and from loamy fine sand to sand in texture. Below a depth of 40 inches the stratified sediments range from silty clay loam to sand in texture.

Zalla loamy fine sand (Za).—This soil is on the flood plain along the Rio Grande, generally at an elevation of 15 to 25 feet above the present riverbed. Most areas occupy the large inside curves of the river, but a few areas are narrow and elongated. There are many mounds and ridges 2 to 5 feet high. Areas of this soil range from about 10 to 90 acres in size. The slopes are convex.

Included in mapping were elongated areas of Rio Grande silt loam and narrow strips of Camargo silty clay loam.

Most of the acreage is either idle or used as pasture, but a few small spots occur in some irrigated fields. The management of soil and irrigation water is difficult. Surface runoff is slow. (Capability units IVe-5, nonirrigated, and IIIs-2, irrigated; Loamy Bottomland range site)

Zapata Series

The Zapata series consists of well-drained, gently sloping soils that are very shallow over caliche. These soils occupy low ridges on upland divides. The slope range is 1 to 5 percent.

In a representative profile (fig. 22) the surface layer consists mainly of grayish-brown loam and contains angular caliche fragments. The fragments make up about 5 to 10 percent of the layer. The underlying material, to a depth of 30 inches, is indurated caliche. The uppermost 3 inches of the caliche is fractured, but the rest is strongly cemented to weakly cemented.

Internal drainage through cracks and fractures in the caliche is medium. Permeability above the caliche is moderate. The available water capacity is low.

Zapata soils are used for range. Response to management is good, and a cover of desirable grasses can be established.

Representative profile of Zapata loam, in an area of Zapata soils, 75 feet north of a county road, 6.5 miles east of its intersection with Farm Road 649. This intersection is approximately 7.0 miles south of the Starr-Jim Hogg county line.

A11—0 to 1 inch, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; massive; hard when dry, friable when moist; 5 percent fragments of angular caliche and rounded chert; calcareous; moderately alkaline; abrupt, smooth boundary.

A12—1 to 8 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; many fine and very fine pores; few threads and films of calcium carbonate; 10 percent angular caliche, 2 to 6 inches long, and rounded chert pebbles; calcareous; moderately alkaline; abrupt, wavy boundary.

C1cam—8 to 11 inches, very pale brown (10YR 8/3) caliche; indurated; laminar; thin, brownish horizontal bands in the upper inch; upper surface of the caliche is smooth but etched and fractured; gradual, wavy boundary.

C2—11 to 30 inches, white (10YR S/2) caliche that is strongly cemented in the upper part but weakly cemented with increasing depth; massive but has fractures and solution channels.

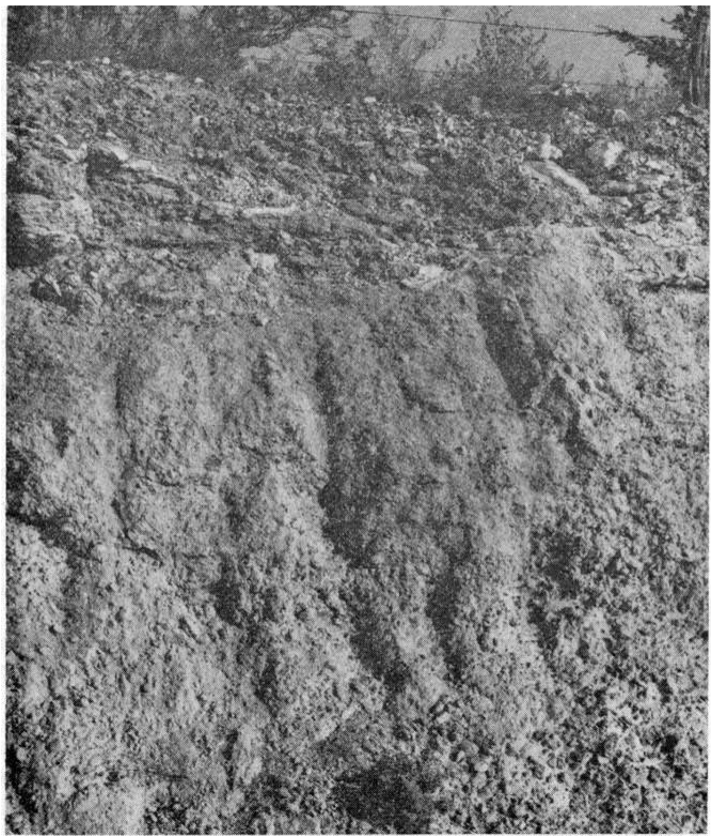

Figure 22.—Profile of Zapata loam.

The A horizon ranges from 2 to 10 inches in thickness, from grayish brown to light brown in color, and from fine sandy loam to clay loam in texture. It is 2 to 25 percent gravel and caliche fragments, by volume. The C1cam horizon is indurated and strongly cemented, but the rest of the C horizon becomes more weakly cemented as depth increases.

Zapata soils (Zp).—These soils are gently sloping. Areas of these soils are irregularly shaped to elongated. They occupy the low ridges of upland divides. The slope range is 1 to 5 percent.

Included in mapping were areas of soils that are 35 percent gravel and caliche fragments, by volume, and areas of reddish, noncalcareous soils that are similar to Zapata soils. Also included were a few caliche outcrops.

The entire acreage is used for range (fig. 23). The use of mechanical equipment is difficult because the soil is very shallow over a layer of cemented caliche. There are many caliche pits within areas of these soils. Runoff is medium. (Capability unit VIIs–2; nonirrigated; Shallow Ridge range site)

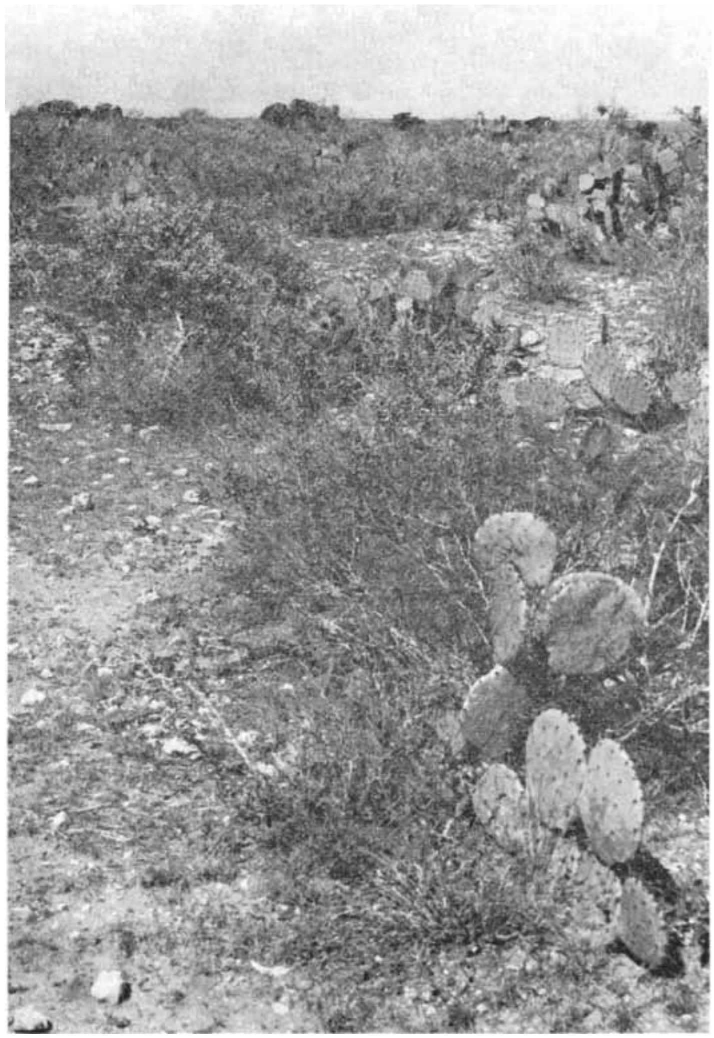

Figure 23.—Typical native vegetation on Zapata soils.

Use and Management of the Soils

This section explains the system of capability grouping used by the Soil Conservation Service and discusses the management of the soils in Starr County by capability units, both nonirrigated and irrigated. Estimated yields of the principal crops are given. Also discussed are the management of soils for range and for wildlife habitat. The properties and features that affect engineering practices are enumerated, mainly in tables.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for wildlife habitat, or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (None in Starr County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or saline; and *c*, shows that the chief limitation is climate that is too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIc-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by nonirrigated capability units

In the following pages each of the nonirrigated capability units in Starr County is described, and suggestions for use and management of the soils are given. The choice of crops that can be produced successfully on nonirrigated soils is limited. The main crops are grain sorghum, cotton, and corn. The chief risk to dryfarming is limited and, usually, poorly distributed rainfall. Under good management, the cropping system selected helps to control erosion, supplies organic matter, and improves the physical condition or tilth of the soil. Including grasses or a crop that produces a large amount of residue in the cropping system increases the organic-matter content. Contour farming, field terraces, diversion terraces, and other measures that control water are needed in some areas. Tillage should be kept to a minimum and should be done only when needed to prepare the seedbed and to control weeds.

The capability classification of each soil is given in the “Guide to Mapping Units.” The land type Pits is not in a nonirrigated capability unit.

Capability Unit IIc-1, Nonirrigated

This unit consists of Ramadero loam, a deep, nearly level, alkaline soil that has firm, moderately permeable lower layers. This soil is flooded for short periods in years when rainfall is above average or during high-intensity rainstorms. It receives water that runs off surrounding areas. The soil is naturally fertile. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is well suited to cotton, grain sorghum, corn, and other cultivated crops. It is also well suited to buffelgrass, blue panicgrass, Coastal bermudagrass, African star-grass, and other hay and pasture plants.

The main management objectives are conserving moisture and maintaining and improving soil tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to provide a continuous supply of organic matter, improve tilth, reduce surface crusting, and reduce evaporation of water from the soil.

Capability Unit IIIe-1, Nonirrigated

This unit consists of Camargo silty clay loam, 1 to 3 percent slopes, a deep, alkaline soil that has friable, moderately permeable lower layers. This soil has a crusty surface layer. It is naturally fertile, and it contains free lime. It tends to be droughty because it contains a large amount of lime. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

Only cotton, grain sorghum, and a few other crops can be grown. Most of the acreage is cultivated, but crops are damaged by lack of moisture in most years and in some years the crop is completely lost.

The main management objectives are conserving moisture and maintaining and improving tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve tilth, reduce surface crusting, check evaporation of soil moisture, and provide a continuous supply of organic matter. In wet years both cultivated crops and pasture grasses respond to some fertilization with nitrogen.

Capability Unit IIIe-2, Nonirrigated

This unit consists of Comitas loamy fine sand, a deep, nearly level to gently undulating, alkaline soil that has very friable, moderately rapidly permeable lower layers. The available water capacity is moderate. Water enters the soil readily, and internal movement of water, air, and plant roots is moderately rapid. The root zone is deep.

This soil is suited to cotton, grain sorghum, watermelons, and other crops. Among the well-suited pasture and hay plants are buffelgrass and blue panicgrass. Lack of moisture is a limitation, and if this soil is cultivated, crop failure can be expected in years when rainfall is below average. Soil blowing occurs where the soil is bare during seasons when the wind velocity is high.

The main management objectives are conserving soil moisture, maintaining and improving fertility and tilth, and controlling soil blowing. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve soil structure and to provide a continuous supply of organic matter. Stripcropping reduces the soil blowing hazard and the wind damage to growing crops. In wet years both cultivated crops and pasture grasses respond to fertilizer, especially nitrogen.

Capability Unit IIIs-1, Nonirrigated

This unit consists of Matamoros silty clay, a deep, nearly level, moderately alkaline soil that has firm, slowly permeable lower layers. The lower layers tend to impede the movement of water, air, and roots. This soil is naturally fertile, and it contains a large amount of lime. The available water capacity is high. Water enters the soil slowly, and internal movement of water, air, and plant roots is slow.

This soil is suited only to cotton, grain sorghum, and a few other crops. Lack of moisture is a limitation, and if the soil is cultivated, crop failure can be expected in years when rainfall is below average.

The main management objectives are maintaining and improving soil tilth and choosing cropping systems that are suited to the soil limitations. Including grain sorghum and other crops that produce a large amount of residue in the cropping system or rotating row crops with deep-rooted grasses are necessary to improve the soil structure. In places surface drains are needed to remove ponded water. In wet years both cultivated crops and pasture grasses respond to fertilizer, particularly nitrogen.

Capability Unit IIIc-1, Nonirrigated

This unit consists of Brennan fine sandy loam, a deep, nearly level, neutral to moderately alkaline soil that has friable, moderately permeable lower layers. This soil has a surface layer and subsurface layer that are free of lime. It is naturally fertile. The available water capacity is high. Water enters the soil readily, and the internal movement of water, air, and plant roots is moderate. The root zone is deep.

The soil is suited to cotton, grain sorghum, and a few other crops. Buffelgrass and blue panicgrass are well suited pasture and hay plants. Lack of moisture is a limitation and crop failure can be expected in years when rainfall is below average.

The main management objectives are conserving soil moisture and maintaining and improving tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve soil structure, reduce the erosion hazard, and provide a continuous supply of organic matter. Farming on the contour is one way of conserving moisture. Terraces are needed in some places, particularly on long slopes. Stripcropping reduces wind damage to growing crops. In wet years both cultivated crops and pasture grasses respond to fertilizer.

Capability Unit IIIc-2, Nonirrigated

This unit consists of deep, nearly level, alkaline soils that have a surface layer of silt loam or silty clay loam overlying friable, moderately permeable lower layers. These soils have a slightly crusty surface layer. They are naturally fertile. The available water capacity is high.

Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

Even where the soils are well managed, only cotton, grain sorghum, and a few other crops can be grown. Buffelgrass and blue panicgrass are well suited pasture and hay plants. Most of the acreage is cultivated, but crop failure is common because of the lack of moisture. The lack of moisture is a limitation, especially in years when rainfall is below average.

The main management objectives are conserving moisture and maintaining and improving tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve tilth, reduce surface crusting, check evaporation of soil moisture, and provide a continuous supply of organic matter.

Capability Unit IIIc-3, Nonirrigated

This unit consists of deep, nearly level, moderately alkaline soils that have a surface layer of silt loam or silty clay loam overlying friable, moderately permeable soil material. These soils have a crusty surface layer. They are naturally fertile, and they contain free lime. They tend to be droughty because they contain a large amount of lime. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

Even where the soils are well managed, only cotton, grain sorghum, and a few other crops can be grown. Most of the acreage is cultivated. Lack of moisture is a limitation, especially in years when rainfall is below average.

The main management objectives are conserving moisture and maintaining tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve tilth, reduce surface crusting, check evaporation of soil moisture, and provide a continuous supply of organic matter. In wet years, both cultivated crops and pasture grasses respond to some fertilization with nitrogen.

Capability Unit IVe-1, Nonirrigated

This unit consists of Delmita fine sandy loam, a moderately deep, nearly level to gently sloping, neutral to mildly alkaline soil that has friable lower layers. Caliche is at a depth of less than 40 inches. When dry, the surface tends to be hard and crusty. This soil is naturally fertile, and it is free of lime. The available water capacity is moderate. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. Soil blowing is a hazard.

Even when the soil is well managed, only cotton, grain sorghum, and a few other crops can be grown. Many old cultivated fields have been reseeded to buffelgrass, blue panicgrass, and other improved pasture grasses. Lack of moisture is a limitation, especially in years when rainfall is below normal. If the soil is managed well, pasture can be expected to produce satisfactory forage during most years.

The main management objectives are conserving moisture, maintaining and improving soil tilth, and controlling soil blowing. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve tilth, reduce surface crusting, check evaporation of soil water, and reduce the soil blowing hazard.

Capability Unit IVe-2, Nonirrigated

This unit consists of Delmita loamy fine sand, a moderately deep, nearly level to gently sloping, neutral to mildly alkaline soil that has friable lower layers. Caliche occurs at a depth of less than 40 inches. This soil is free of lime. The available water capacity is moderate. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. Soil blowing is a hazard.

Even where the soil is well managed, only cotton, grain sorghum, and a few other crops can be grown. Many old cultivated fields have been reseeded to buffelgrass, blue panicgrass, and other improved pasture grasses with satisfactory results. Farming is risky because of the soil blowing hazard.

The main management objectives are controlling soil blowing, conserving moisture, and maintaining and improving soil fertility and tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve soil tilth, check evaporation of soil water, and reduce the soil blowing hazard. Also, a continuous supply of organic matter is needed to maintain soil fertility. Stripcropping is effective in controlling soil blowing. In wet years both cultivated crops and pasture grasses respond to some fertilizer, especially nitrogen.

Capability Unit IVe-3, Nonirrigated

This unit consists of McAllen fine sandy loam, a deep, nearly level to gently sloping, moderately alkaline soil that has friable, moderately permeable lower layers. This soil is naturally fertile, and it contains free lime. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. Water erosion is a slight hazard. The root zone is deep.

This soil is suited to cotton, grain sorghum, and a few other crops. Buffelgrass and blue panicgrass are among the well-suited pasture and hay plants. Most of the acreage is used for range, but a few areas are cultivated. Lack of moisture is a limitation, and crop failure can be expected in years when rainfall is below average.

The main management objectives are conserving soil moisture, maintaining and improving soil tilth, and controlling erosion. Farming on the contour is one way of conserving moisture. Terraces are needed on long slopes. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is necessary to improve soil structure and tilth, reduce the erosion hazard, and provide a continuous supply of organic matter. In wet years, both cultivated crops and pasture grasses respond to some fertilizer, especially nitrogen.

Capability Unit IVe-4, Nonirrigated

This unit consists of Rio Grande silt loam, 1 to 3 percent slopes, a deep, gently sloping, moderately alkaline soil that has friable, moderately permeable lower layers. This soil has a crusty surface layer. It is droughty because it contains a large amount of lime. The soil is naturally fertile. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

Even where the soil is well managed, only cotton, grain sorghum, and a few other crops can be grown. Most of the acreage is cultivated, and the productivity of suitable crops can be expected to increase in years when rainfall is above average. Well-suited pasture and hay plants are buffelgrass and blue panicgrass.

Capability Unit IVe-5, Nonirrigated

This unit consists of Zalla loamy fine sand, a deep soil that formed in alluvium on flood plains, where it is frequently flooded. This soil contains free lime. Water enters the soil readily, and internal movement of water, air, and plant roots is rapid.

This soil is used mainly for grazing. It is better suited to native grasses and suitable varieties of introduced grasses than to other plants. It is not suited to cultivated crops, because of the flooding. Lack of moisture is a limitation, except during seasons when the water table is high and extra water is available. Many sites are suitable for improvement as wildlife habitat and recreational areas.

Maintaining an adequate cover of vegetation is important. Desirable species of grasses can be established by seeding or sodding and then maintained by regulated grazing or mowing. In some areas control of brush and weeds is needed.

Capability Unit IVw-1, Nonirrigated

This unit consists of Grulla clay, a deep, nearly level, moderately alkaline soil that has very firm, very slowly permeable lower layers. These layers tend to impede the movement of water, air, and roots. This soil is naturally fertile, and it contains a large amount of lime. The available water capacity is high. Water enters the soil slowly, and internal movement of water, air, and plant roots is very slow.

This soil is suited only to cotton, grain sorghum, and a few other crops. Lack of moisture is a limitation, and in cultivated areas crop failure can be expected in years when rainfall is below average.

The main management objectives are maintaining and improving soil tilth and choosing a cropping system that is suited to the soil limitations. Including grain sorghum and other crops that produce a large amount of residue in the cropping system or rotating row crops with deep-rooted grasses is necessary to improve soil structure. In places surface drains are needed to remove ponded water. In wet years both cultivated crops and pasture grasses respond to some fertilizer, particularly nitrogen.

Capability Unit Vw-1, Nonirrigated

This unit consists of deep clayey soils that have very firm, very slowly permeable, somewhat poorly drained, clayey lower layers. These soils occupy slight depressions that are frequently flooded. In some years they are under water for periods of several months. They are naturally fertile. The available water capacity is high. Water enters the soil very slowly, and the movement of water, air, and plant roots is very slow.

These soils are better suited to native grasses and introduced grasses than to other plants, and they are used mainly for grazing or as unmanaged areas. They are not suited to cultivated crops, because of the flooding. There are sites that are suitable for irrigation reservoirs or wildlife habitats.

Maintaining grass is important. In some areas brush control is needed, and surface drainage enhances the value of these soils for growing forage plants.

Capability Unit Vw-2, Nonirrigated

This unit consists of Alluvial land, a land type that is deep and nearly level to sloping. The soil material is loamy and consists of mixed alluvial sediments on flood plains. This land type is frequently flooded. Water enters the soil material readily, and the internal movement of water, air, and plant roots is rapid.

This land type is better suited to native grasses or suitable introduced grasses than to other plants, and it is used for range. It is not suited to cultivated crops, because of the flooding. There are suitable sites for wildlife habitat.

Maintaining an adequate cover of vegetation is important. Control of brush and weeds is needed in some areas.

Capability Unit VIe-1, Nonirrigated

This unit consists of deep, nearly level and gently undulating to rolling soils that have a surface layer of loose, rapidly permeable fine sand. The organic-matter content, the fertility, and the available water capacity are low. Water enters the soil readily, and internal movement of water, air, and plant roots is rapid. The root zone is deep. The soil is droughty because of the low available water capacity and the low rainfall. Soil blowing is a problem if the soils are bare.

These soils are better suited to native grasses than to other plants, and they are used for range. They are not suited to cultivated crops. Lack of moisture is a limitation, especially in years when rainfall is below normal. There are suitable sites for wildlife habitat and recreational areas.

The main management objective is establishing an adequate cover of vegetation. An adequate cover checks soil blowing and provides a continuous supply of organic residue.

Capability Unit VIc-1, Nonirrigated

This unit consists of Copita fine sandy loam, a moderately deep, nearly level to gently undulating soil that has friable, moderately permeable lower layers. This soil tends to be droughty because it contains a large amount of lime. It is naturally fertile. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is better suited to native grasses and some varieties of introduced grasses than to other plants, and it is used for range. It is not suited to cultivated crops because it is droughty and rainfall is low. Lack of moisture is a limitation, especially in seasons when rainfall is below normal. There are few suitable sites for farm ponds, because sandstone occurs at some depth below about 25 inches. There are suitable sites for wildlife habitat and recreational areas.

The main management objective is establishing an adequate cover of vegetation. Adequate cover increases intake of water and decreases the hazard of sheet erosion. Brush control is needed in most areas.

Capability Unit VIc-2, Nonirrigated

This unit consists of Garceno clay loam, a deep, nearly level soil that has moderately permeable lower layers. This soil tends to be droughty because it contains a large amount of lime. It is naturally fertile. The available water capacity is high. The surface crusts and, consequently, water enters the soil slowly. Internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is better suited to native grasses and adapted varieties of introduced grasses than to other plants, and it is used for range. It is not suited to cultivated crops. There are suitable sites for farm ponds and for wildlife habitat and recreational areas. Lack of moisture is a limitation, especially in years when rainfall is below normal.

The main management objective is establishing an adequate cover of vegetation. Brush control is needed in most areas.

Capability Unit VIIe-1, Nonirrigated

This unit consists of Maverick soils, eroded, which are moderately deep, undulating soils that have a clayey surface layer and firm, slowly permeable, saline, clayey lower layers. Much of the original surface layer has been removed by erosion, and gullies and washes occur in most areas. Runoff is rapid because of the slope and the clayey texture. Water enters the soil slowly, and internal movement of water, air, and plant roots is slow.

These soils are better suited to native grasses than to other plants, and they are used for range. They are not suitable for cultivation, because of the salinity, the runoff, and the erosion hazard.

The management objectives are controlling erosion and conserving the water received as rain. Adequate cover reduces loss of soil from water erosion and provides a supply of organic matter. Brush control is needed in some areas.

Capability Unit VIIs-1, Nonirrigated

This unit consists of deep to moderately deep, nearly level to undulating saline soils that have a clay surface layer and plastic, saline, clayey lower layers. Even though saline, these soils are fertile. The internal movement of water, air, and plant roots is restricted.

These soils are used for range, but the choice of desirable grasses is restricted. The soils are not suitable for cultivation; they contain excess salts and are droughty.

The main management objective is establishing a good cover of vegetation. The crops respond slowly to treatment.

Capability Unit VIIs-2, Nonirrigated

This unit consists of very shallow and shallow, gently sloping and undulating to hilly soils that are underlain by cemented gravel and caliche. The available water capacity is low because of the limited soil depth. Water enters the soil readily, but the soils are droughty because of the slope and the low rainfall.

These soils are better suited to native and adapted introduced grasses than to other plants, and they are used for range. They are not suitable for cultivation. There are suitable sites for wildlife habitat and recreation areas.

The main management problem is control of soil erosion. An adequate plant cover reduces the loss of soil, increases the intake of water, and provides a continuous supply of organic matter. Brush control is effective in some areas, and where the soils are not too shallow, the response to mechanical treatment is good.

Management by irrigated capability units

Much of the acreage in Starr County is suitable for irrigation but lacks an adequate supply of good-quality water. About 35,000 acres are irrigated, mainly on the nearly level flood plains and river terraces along the Rio Grande. The principal source of irrigation water is the Rio Grande, but in the southern and southeastern parts of the county, there are also several irrigation wells that tap the ground-water reservoir. The wells are along the Rio Grande in a belt that averages less than 2 miles in width. They are generally less than 75 feet deep.

The quality of the water used for irrigation has an important influence on crop response. The quality of the river water is normally good; the total dissolved salts range from 450 to 900 parts per million, and the sodium adsorption ratio is less than 6 (6). The ground water generally has a high to very high salinity hazard and a low to medium sodium hazard; the total dissolved salts range from about 600 to 1,800 parts per million, and the sodium adsorption ratio is generally less than 6 (2).

The main management objective in using an irrigation system is to distribute the necessary amount of water uniformly over the field without causing erosion. A conservation irrigation system is important because it saves water and makes crop production more economical. The better irrigation systems are designed to use the water received as rainfall efficiently, and in an area of perennial water shortages, to use irrigation water efficiently and without waste. Excessive irrigation results in the leaching of plant nutrients from the soil, and if continued, in waterlogging of the soil and in accumulation of harmful salts.

Irrigation practices, crop selection, and soil management must be fitted to the needs of the soil and the quality of the irrigation water. Proper management of irrigated soils requires a properly designed and properly used irrigation system. Most of the soils in this county have a surface layer of silty clay loam, fine sandy loam, or silt loam and moderately permeable lower layers. Consequently, surface irrigation systems are better suited to the soils and are used more frequently than other kinds of systems. Drop structures are used to control erosion in irrigation ditches. Underground pipelines also reduce water loss and eliminate open ditches.

Good farming practices are needed. A cropping system is needed that helps to control erosion, supplies organic matter, improves the physical condition or tilth of the soils, and helps to control insects and plant diseases. Including a grass crop or a field crop that produces a large amount of residue in the cropping system adds to the organic-matter content. Nitrogen added to the crop residue hastens its decomposition and provides available nitrogen for the crops. Both cultivated crops and pasture grasses respond to fertilizer. Fertilizer should be applied according to the results of soil tests.

In the following pages, each of the irrigated capability units in Starr County is described, and suggestions for the use and management of the soils are given. The capability classification of each soil is given in the "Guide to Mapping Units." Soils of the Catarina, Jimenez, Maverick, Montell, Quemado, Tiocano, Rio, Viboras, and Zapata series and the land type Pits are not in an irrigated capability unit.

Capability Unit I-1, Irrigated

This unit consists of Brennan fine sandy loam, a deep, nearly level soil that has lower layers of friable sandy clay loam. The upper part of the sandy clay loam is free of lime, but the lower part contains a large amount of lime. This soil is naturally fertile. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is well suited to cool-season vegetables, cotton, grain sorghum, and other crops. Only a few areas are irrigated.

Good soil management is needed to maintain or improve tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The crop residue should be worked into the soil surface to maintain organic-matter content and to improve tilth. Land leveling is needed to keep erosion to a minimum and to increase the efficiency of water use. The cuts need to be kept to a minimum depth so that they do not expose layers of material that has a high content of lime. Crops respond well to fertilizer.

Capability Unit I-2, Irrigated

This unit consists of deep, nearly level, silty soils that have friable lower layers. These soils are naturally fertile. The available water capacity is high. Water enters the soil readily, but the internal movement of water may be restricted by layers of sediment that have contrasting texture. Internal movement of air and plant roots is moderate. The root zone is deep.

These soils are well suited to truck crops, cotton, and grain sorghum. Most of the acreage is used for crops, but some is used for improved pasture.

Good soil management is needed to maintain or improve tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The residue should be kept on or near the surface. Land leveling keeps soil erosion to a minimum and increases the efficiency of water use. Care should be taken in making the cuts because of the contrasting texture in the subsurface and lower layers. In places the cuts expose undesirable material and backfilling with more desirable material is needed. Crops respond well to fertilizer.

Capability Unit I-3, Irrigated

This unit consists of Garceno clay loam, a deep, nearly level soil that has lower layers of moderately permeable clay loam. These lower layers contain large amounts of lime and moderate amounts of soluble salts. This soil is naturally fertile. The available water capacity is high. Water enters the soil slowly because of the thin crust on the surface. Internal movement of air and plant roots is moderate. The root zone is deep.

This soil is suited to cotton, grain sorghum, and other crops.

Good soil management is needed to maintain or improve tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable.

Residue should be kept on or near the soil surface. Land leveling keeps soil erosion to a minimum and increases the efficiency of water use. Care needs to be taken in designing the irrigation system. If the cuts are deeper than 12 inches, they expose the lime- and salt-containing lower layers. Crops respond well to fertilizer.

Capability Unit I-4, Irrigated

This unit consists of Ramadero loam, a deep, nearly level soil that has moderately permeable lower layers. This soil is naturally fertile. The available water capacity is high. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is well suited to cool-season vegetables, cotton, grain sorghum, and other crops.

Good management is needed to maintain or improve tilth and to make efficient use of the irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. Crop residue should be worked into the soil surface to maintain organic-matter content and to improve tilth. Land leveling keeps erosion to a minimum and improves the efficiency of water use. Crops respond well to fertilizer.

Capability Unit IIe-1, Irrigated

This unit consists of Camargo silty clay loam, 1 to 3 percent slopes, a deep friable soil that has stratified lower layers. The available water capacity is high. Water enters the soil readily, and internal movement of air and plant roots is moderate.

This soil is well suited to cool-season vegetables, cotton, grain sorghum, and other crops. Most of the acreage is used for crops, but some is used for improved pasture.

Controlling soil erosion and using irrigation water efficiently are problems. Land leveling keeps soil erosion to a minimum and increases the efficiency of water use. Care should be taken in making the cuts because of the contrasting texture in the subsurface and lower layers. In places the cuts expose undesirable material, and backfilling with more desirable material is needed.

Good soil management consists of practices that maintain tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The residue should be worked into the soil to maintain organic-matter content and to improve tilth. Crops respond well to fertilizer.

Capability Unit IIe-2, Irrigated

This unit consists of deep and moderately deep, nearly level to gently sloping and gently undulating soils that have a surface layer of fine sandy loam and lower layers of friable sandy clay loam. The lower layers contain a large amount of lime. This soil is naturally fertile. The available water capacity is high. The internal movement of water, air, and plant roots is moderate.

This soil is well suited to cool-season vegetables, cotton, grain sorghum, and other crops.

A large acreage is suitable for irrigation, but only a few areas are irrigated. Care needs to be taken in designing the irrigation system. If land leveling is done, the cuts should not be so deep that they expose large areas of the lime-containing lower layers.

Good soil management is needed to maintain or improve tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The crop residue needs to be worked into the surface to maintain organic-matter content and to improve tilth. Crops respond well to fertilizer.

Capability Unit IIe-3, Irrigated

This unit consists of Delmita fine sandy loam, a moderately deep, nearly level to gently sloping soil that has lower layers of friable, lime-free sandy clay loam underlain by caliche. The surface layer is hard when dry. The available water capacity is moderate, and the internal movement of water, air, and plant roots is moderate.

This soil is well suited to most of the crops grown in the county.

Care is needed in designing the irrigation system. If land leveling is done, care needs to be taken to keep the soil within a desirable thickness over the caliche in areas where cuts are made. The irrigation system has to be designed, installed, and used properly to increase the efficiency of irrigation and to control soil erosion.

Good soil management is needed to maintain or improve tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The residue needs to be worked into the surface to maintain organic-matter content, improve tilth, and prevent damage from soil blowing. Crops respond well to fertilizer.

Capability Unit IIe-4, Irrigated

This unit consists of Rio Grande silt loam, 1 to 3 percent slopes, a deep soil that has lower layers of friable, stratified very fine sandy loam, silt loam, and silty clay loam. This soil is naturally fertile. The available water capacity is high. Water enters the soil easily, but in places its movement is restricted by contrasting layers of sediments. Internal movement of water, air, and plant roots is moderate. The root zone is deep.

This soil is well suited to cool-season vegetables, cotton, grain sorghum, and other crops.

Controlling soil erosion and using irrigation water efficiently are problems. Land leveling keeps soil erosion to a minimum and increases the efficiency of irrigation. Care should be taken in making the cuts because of the contrasting texture in the different strata of the subsurface and lower layers. In places the cuts expose undesirable material, and backfilling with more desirable material is needed.

Good soil management consists of practices that maintain tilth. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The residue should be worked into the soil to maintain organic-matter content and to improve tilth.

Capability Unit IIs-1, Irrigated

This unit consists of Matamoros silty clay, a deep, nearly level soil that has lower layers of stratified, firm silty clay, silty clay loam, and silt loam. This soil is naturally fertile. The available water capacity is high. Water enters the soil slowly, and internal movement of air and plant roots is slow. The root zone is deep.

This soil is well suited to truck crops, cotton, and grain sorghum. Most of the acreage is used for crops, but some is used for pasture.

Good management is needed to maintain or improve tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The residue should be kept on or near the surface. Land leveling increases the efficiency of water use. Where adequate natural drainage is not available, surface field ditches are used to remove excess water received as rain. Crops respond to fertilizer.

Capability Unit IIIe-1, Irrigated

This unit consists of Delmita loamy fine sand, a moderately deep, nearly level to gently sloping soil that has friable lower layers underlain by caliche. The available water capacity is moderate. Water enters the soil readily, and internal movement of air and plant roots is moderate.

This soil is suited to most of the crops grown in the county.

Good soil management is needed to maintain or improve fertility and tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The sprinkler system of irrigation is better suited than other systems of irrigation. Land leveling keeps erosion to a minimum and increases the efficiency of irrigation. Care should be taken in making the cuts because of the soil depth. In places the cuts expose undesirable material, and backfilling with more desirable material is needed.

Capability Unit IIIw-1, Irrigated

This unit consists of Grulla clay, a deep, nearly level soil that has very firm and plastic, stratified lower layers. This soil is naturally fertile. The available water capacity is high. Water enters the soil slowly, and internal movement of air and plant roots is very slow. The root zone is deep.

This soil is suited to truck crops, cotton, and grain sorghum.

Good soil management is needed to maintain or improve tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. Growing deep-rooted perennial grasses is also desirable because they help to loosen the tight lower layers. Crop residue should be kept on or near the surface. Land leveling increases the efficiency of water use and prevents the ponding of surface water. Where adequate natural drainage is not available, surface field ditches are used to remove excess water received as rain. Crops respond well to fertilizer.

Capability Unit IIIs-1, Irrigated

This unit consists of Comitas loamy fine sand, a deep, nearly level to gently undulating, alkaline soil that has very friable, moderately rapidly permeable lower layers. The available water capacity is moderate. Water enters the soil readily, and internal movement of water, air, and plant roots is moderately rapid. The root zone is deep.

This soil is well suited to cotton, grain sorghum, watermelons, and other crops.

Good management is needed to maintain or improve fertility and tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The sprinkler system of irrigation is better suited to this soil than other systems of irrigation. Crops respond well to fertilizer.

Capability Unit IIIs-2, Irrigated

This unit consists of deep, nearly level to rolling, loose, moderately to rapidly permeable soils that have a surface layer of fine sand or loamy fine sand. The available water capacity is low. Water enters the soil readily, and internal movement of water, air, and plant roots is moderate to rapid. The root zone is deep.

These soils are suited to cotton, grain sorghum, watermelons, and other crops, but only a small acreage is used for crops.

Good management is needed to maintain or improve fertility and tilth and to make efficient use of irrigation water. Including grain sorghum and other crops that produce a large amount of residue in the cropping system is desirable. The sprinkler system of irrigation is better suited than other systems of irrigation. Crops respond well to fertilizer.

Capability Unit Vw-1, Irrigated

This unit consists of Grulla clay, depressional, a deep soil that has stratified, very firm and plastic, clayey lower layers. After heavy rains water remains on the surface for periods of more than 3 months, unless surface drainage ditches have been provided. This soil is naturally fertile. The available water capacity is high. Water enters the soil very slowly, and internal movement of air and plant roots is very slow. The root zone is deep.

This soil is suited to pasture grasses.

Good soil management is needed to maintain or improve tilth. The growing of deep-rooted perennial grasses is desirable to help loosen the tight lower layers. Residue should be kept on or near the soil surface. Land leveling increases the efficiency of water use and prevents ponding of surface water. Where natural adequate drainage is not available, surface field ditches are needed to remove excess water received as rain.

Estimated Yields

Table 2 gives estimated yields of cotton and grain sorghum on both nonirrigated and irrigated soils and of onions, carrots, and cantaloupes on irrigated soils. It lists only soils that are suitable and generally used for crops.

To obtain the estimated yields given in table 2, the following can be assumed.

For nonirrigated soils:

1. Moisture received as rainfall is conserved.
2. Soil-improving crops and crops that produce a large amount of residue are included in the cropping system.
3. Grazing is properly controlled, and good harvesting practices are used.
4. Insects, weeds, and plant diseases are controlled by consistent use of timely measures.
5. Suitable crop varieties are used.

For irrigated soils:

1. Moisture received as rainfall is conserved.
2. Irrigation water of suitable quality is used.
3. Applications of irrigation water are timed to meet the needs of the soil and the crops.
4. Design of the irrigation system is proper, and its use is efficient.
5. Crop residue is managed to maintain tilth.
6. Tillage is timely and kept to a minimum.
7. Insects, weeds, and plant diseases are controlled by consistent use of effective measures.
8. Fertilizer is applied according to the results of soil tests and the needs of the crop.
9. Suitable crop varieties are seeded at recommended rates.

Use of the Soils for Range

By DEAN ISAACS, range conservationist, Soil Conservation Service.

Starr County is one of the oldest grazing areas in the State, and some of it has been grazed by domestic livestock for nearly 300 years. Originally, nearly all the range was open grassland and consisted of a mixture of mid grasses, short grasses, and a few woody plants.

At present native grassland amounts to about 90 percent of the farmland in the county, or about 699,000 acres, and livestock raising is a major enterprise. Virtually all the livestock are cattle, but there are a few Spanish goats. Most of the ranches are cow and calf operations, and some have a few stocker cattle. The average ranch is about 8,000 acres, but the ranches range from about 1,000 to 70,000 acres in size.

The forage produced on rangeland is marketed through the sale of livestock and livestock products, and consequently the success of the livestock enterprise depends heavily on the way the grassland is managed. Most of the range in this county is now producing less than 25 percent of its potential (4), because it has been overstocked.

As a result, woody plants, annuals, and other droughty undesirable plants have invaded. An extensive acreage of range that was infested with brush has been root-plowed and seeded to buffelgrass and blue panicum. These two introduced grasses are used successfully for range where sound grazing management is practiced.

The native grasses grow better from the middle of April through October than at other times, but in almost every year, some dormancy occurs in July as a result of the recurrent droughts in summer. If enough moisture is available, the grasses start growing again about the middle of August and continue to grow until late October when they become semi-dormant because of the cold weather. Early growth is frequently retarded by the lack of moisture in winter and early in spring.

Range sites and condition classes

The soils are classified into range sites according to their ability to produce native vegetation. Different kinds of soil produce different kinds and amounts of grasses and other forage. The inherent productive capacity of different areas of rangeland depends principally on the combined effect of the soils and the climate. Each range site has its own soils and environmental conditions, and these produce a characteristic plant community.

Climax vegetation is the stabilized plant community on a particular range site. It reproduces itself and remains unchanged so long as the environment does not change. It is generally the most productive combination of forage plants on a range site. Throughout most of this county, the climax vegetation consists of the kinds of plants that were growing there when the county was first settled.

Livestock graze selectively and seek the plants that are most palatable. Decreasers are plants that decrease under continuous heavy grazing. Increasers are plants that normally increase as the decreasers decline. These plants are often shorter and less palatable than the decreasers. If the increasers are grazed heavily, they may decline and be replaced by invader plants. Invaders are plants not ordinarily present in the original vegetation on the site. Many, such as brush, are not suitable for grazing, and others are the less palatable, low-growing grasses and weeds.

Four range condition classes are recognized. This classification is based on the measurements or estimates of the percentage of decreasers and increasers in the present vegetation in comparison with the percentage in the climax vegetation. A range is in excellent condition if 75 percent or more of the plants are climax vegetation. It is in good condition if the percentage is between 50 and 75, in fair condition if the percentage is between 25 and 50, and in poor condition if the percentage is 25 or less. The remaining vegetation would consist mainly of invaders.

Recognition of the range site and condition class is useful in determining the management of grazing and the treatment needed to maintain or improve the range. Range that is kept in good or excellent condition provides high yields of forage and is protected against excessive erosion and loss of water. Local representatives of the Soil Conservation Service can help make range-site and range-condition determinations and can help in the planning of a management program that will improve or maintain the condition of the range.

Descriptions of range sites

Range sites are significant for planning the treatment and management of range because they have distinguishing characteristics that are easily recognized. The degree of grazing depends on the habits of the various livestock and on the palatability of the forage on the site.

In a pasture there are generally several range sites, but one site is generally preferred by the grazing livestock. This one is the key site that can be used as a basis for grazing management in the entire pasture. If the key site is managed correctly, the rest of the pasture will improve.

The 14 range sites significant to range management and livestock raising in Starr County are briefly described in the following paragraphs. In the description of each site, the plants in the climax vegetation or potential plant community are named, the principal invaders are listed, and the yields of herbage to be expected in favorable and unfavorable years are given.

Bottomland Range Site

The soils that make up this site are deep, nearly level, calcareous clay and silty clay. These soils are adjacent to the Rio Grande and in the valleys of its larger tributaries. This site is of minor extent. Most areas receive extra water from runoff or from flooding by the river and the major drainageways. In some areas the water table is high. The soils are naturally fertile, and their ability to store water and plant nutrients is good.

The original vegetation was grass, but large trees grew along the streambanks, and there were scattered stands of trees throughout the site. The trees were mainly hackberry and Rio Grande ash.

Decreasers make up about 80 percent, by weight, of the grasses in the potential plant community, and increasers make up about 20 percent. The decreasers are fourflowered trichloris, sacaton, cottontop, and in a few spots, common reedgrass and giant reedgrass. Among the increasers are plains bristlegrass, Texas bristlegrass, and pink pappusgrass.

If the condition of the range deteriorates, the site is invaded by curly mesquite, buffalograss, crabgrass, mesquite, spiny hackberry, retama, willow, whitebrush, and huisache.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 2,500 pounds per acre, air-dry weight, in unfavorable years to 5,000 pounds per acre in favorable years.

Clay Loam Range Site

This site consists only of Garceno clay loam, which is a deep, nearly level, calcareous soil that occurs on uplands. This soil contains a large amount of lime. It tends to be droughty. Permeability is moderate, the available water capacity is high, but getting water into the soil is a problem. The control of water erosion is not a problem, but in places where the natural vegetation has been removed by overgrazing, some sheet erosion has taken place.

A mixture of mid and short grasses and scattered stands of guajillo make up the potential plant community. Decreasers make up about 60 percent, by weight, of the grasses in the potential plant community, and increasers make up about 40 percent. Among the decreasers are Arizona cottontop, twoflowered trichloris, plains bristlegrass, and lovegrass tridens. Among the increasers are curly mesquite, buffalograss, Texas bristlegrass, pink pappusgrass, and slim tridens.

If the range is overgrazed and its condition declines, the site is invaded by red grama, whorled dropseed, red three-awn, and annual weeds. Other common invaders are woody species of lotebush, guayacan, goatbush, spiny hackberry, a scattering of mesquite trees, and a greatly increased but generally not dominant stand of guajillo.

Sufficient cover should be maintained. Seeding is generally successful if the soil is broken and brush is controlled.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 800 pounds per acre, air-dry weight, in unfavorable years to 3,000 pounds per acre in favorable years.

Deep Sand Range Site

This site consists only of Sarita fine sand, a deep, nearly level to gently undulating soil. The available water capacity is low. Soil blowing is a hazard, and dunes tend to form in some areas.

The original vegetation was grass that grew on open land.

Decreasers make up about 70 percent, by weight, of the potential plant community, and increasers make up about 30 percent. The main decreasers are seacoast bluestem, crinkleawn, and tanglehead. Other decreasers are brown-seed paspalum, Texasgrass, and a few switchgrass plants. Among the increasers are knotroot panicum, fringeleaf paspalum, hooded windmillgrass, sand dropseed, sand witchgrass, and Pan American balsamscale.

As the condition of the range deteriorates, the site is invaded by red lovegrass, fringed signalgrass, white snake-cotton, croton, three-awn, and either scattered trees or stands of mesquite, hackberry, and catclaw. Other invaders are bluewood and pricklypear.

Seeding is difficult because, except in the most favorable seasons, the surface dries out before the seeds can germinate. Seasonally high winds sandblast the seedlings and destroy them as they emerge. Decreaser grasses thin out and lose vigor in periods of drought. After a period of drought, grazing should be carefully managed and needs to be deferred until the density and vigor of desirable plants is restored. On this site production of shallow-rooted grasses is poor, but that of deep-rooted grasses is good. Forage is generally of lower nutritive quality on this site than on other sites.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 2,000 pounds per acre, air-dry weight, in unfavorable years to 6,000 pounds per acre in favorable years.

Gravelly Ridge Range Site

This site consists only of the Jimenez-Quemado association. The soils are shallow, undulating to hilly, very gravelly loams. Gravel occurs throughout the profile, and there is a definite gravelly appearance to the surface. The surface gravel aids moisture intake and helps check erosion.

The climax vegetation consists of desert grasses and a considerable number of shrubs.

Decreasers make up about 45 percent, by weight, of grasses in the climax vegetation, and increasers make up about 40 percent by weight, of grasses and 15 percent of woody plants. The decreasers are Arizona cottontop, pink pappusgrass, tanglehead, trichloris, and lovegrass tridens. Among the increaser grasses are slim tridens, hooded windmillgrass, Texas bristlegrass, perennial three-awn, and fall witchgrass. Among the woody increasers are baretta, kidneywood, southwest bernardia, guajillo, and ephedra.

If the condition of the range declines, the site is invaded by red grama, gummy lovegrass, red three-awn, whorled dropseed, and woody species of blackbrush, amargoso, and paloverde. There is also considerable bare ground.

The pebbles on the site are small and rounded and not a serious obstacle to the use of mechanical equipment. Response to breaking the soil and to seeding is good.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 300 pounds per acre, air-dry weight, in unfavorable years to 2,000 pounds per acre in favorable years.

Gray Sandy Loam Range Site

The soils that make up this site are deep and moderately deep, nearly level to gently undulating fine sandy loams of the uplands. These soils contain a large amount of lime. Water enters the soil readily when there is adequate cover. The available water capacity is high, but the low erratic rainfall and the high content of lime cause the soils to be droughty. Lack of cover results in crusting and greatly increased runoff, which in turn results in sheet erosion.

Decreasers make up about 55 percent, by weight, of the climax vegetation, and increasers make up about 45 percent, by weight. The major decreasers are Arizona cottontop, pinhole bluestem, and plains bristlegrass. Other decreasers are trichloris, lovegrass tridens, and tanglehead. The increaser grasses are hooded windmillgrass, Texas bristlegrass, pink pappusgrass, slim tridens, fall witchgrass, and hairy grama, and the few woody increasers are kidneywood, ratany, guajillo, cenizo, and ebony.

If the condition of the range deteriorates at all, the site is invaded by red grama, Halls panicum, red lovegrass, red three-awn, and annuals. Invading underbrush generally grows to a height of less than 6 feet.

The response to reseeding is good. Careful management of grazing is needed to maintain sufficient cover and litter to prevent excessive runoff.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 1,200 pounds per acre, air-dry weight, in unfavorable years to 3,000 pounds per acre in favorable years.

Laguna Range Site

This site consists only of Tiocano-Rio complex, which occurs in low, depressed areas. These soils have clay and clay loam textures. Water stands in the depressed areas for varying lengths of time. This extra water enables the plants to grow better and remain green longer on this site than on other sites.

The plant community varies with the frequency of flooding and the depth of the flood water. Among the grasses are Hartweg paspalum, spike dropseed, white tridens, and buffalograss. The invaders are creeping lovegrass, spiny aster, huisache, and retama.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 1,000 pounds per acre, air-dry weight, in unfavorable years to 4,000 pounds per acre in favorable years.

Loamy Bottomland Range Site

The soils that make up this site are deep, silty and loamy soils. They are on flood plains where they receive flood-water and, from higher areas, runoff. The floods are less frequent and smaller since reservoirs have been established on the Rio Grande upstream from Starr County.

A great variety of plants grow on this site because of the variation in flooding and because the seeds of many plants have been carried here by floodwater. Cottonwood, Rio Grande ash, and hackberry trees occur naturally.

Grass, forbs, and some woody plants make up the potential plant community. When the range is overused, the decreasers are fourflowered trichloris, sacaton, Texas bristle-grass, vine-mesquite, and white tridens. The increasers are bristlegrass, pink pappusgrass, and buffalograss.

Common invaders are annual weeds, mesquite, huisache, and retama. Other invaders are bermudagrass, giant reed-grass, and other introduced grasses.

The total annual yield of herbage on the site, in excellent condition, ranges from approximately 1,000 pounds per acre, air-dry weight, in unfavorable years to 4,000 pounds per acre in favorable years.

Loamy Sand Range Site

The soils that make up this site are deep and moderately deep, nearly level to gently undulating loamy fine sands. Soil blowing is a hazard when the plant cover is removed.

Plants tend to grow in thin open stands. The climax plant community consisted of seacoast bluestem, crinkleawn, tanglehead, knotroot panicum, brownseed paspalum, three-awn, and hooded windmillgrass. Western indigo and species of snoutbeans are important climax forbs.

Under heavy grazing, the decreasers are bluestem, crinkleawn, and tanglehead and the increasers are knot-root panicum, three-awn, and hooded windmillgrass.

Invaders are mesquite, red lovegrass, annual weeds, and croton.

This site can be reseeded successfully. Buffalograss, an introduced grass, has been used for this purpose in recent years.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 1,000 pounds per acre, air-dry weight, in unfavorable years to 3,000 pounds per acre in favorable years.

Ramadero Range Site

This site consists only of Ramadero loam, a nearly level soil that occurs mainly in long, narrow drainageways or on valley floors. The drainage channels are not well defined in most areas. This site ordinarily receives runoff water from surrounding areas, and in some places it has received as overwash a mantle of sandy loam or silty clay loam.

The original vegetation was grass that grew on open land, and a high proportion of it was flourflowered trichloris.

Decreasers make up about 70 percent, by weight, of the potential plant community, and increasers make up about 30 percent. The decreasers are mainly flourflowered trichloris and plains bristlegrass. Other decreasers are Arizona cottontop, lovegrass tridens, and big cenchrus. Among the increasers are Nash windmillgrass, Texas bristlegrass, buffalograss, and pink pappusgrass.

When the condition of the range deteriorates, the site is invaded by tumble windmillgrass, whorled dropseed, Halls panicum, perennial three-awn, and western ragweed. The stands of large underbrush and large mesquite trees become very dense and make the site inaccessible in many places.

This range site is a preferred grazing site, but fencing is impractical because the areas are generally long and narrow. Consequently, the distribution of grazing is a problem. If overgrazed, the site is invaded by dense stands of brush that are an obstacle to working livestock and to grazing. Frequent deferment of grazing, preferably for part of the growing season each year, is required to maintain a high-producing grass community. This range site is used for grazing along with other range sites.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 2,000 pounds per acre, air-dry weight, in unfavorable years to 5,500 pounds per acre in favorable years.

Rolling Hardland Range Site

This site consists only of Maverick soils, eroded, which are undulating and consist of calcareous clay underlain by clay and shale. These soils are generally saline and, in eroded areas, strongly saline. They are droughty because of the combination of runoff, salinity, and tightness of the soils. Water erosion is a hazard because of the slope. Roots can readily penetrate the parent material.

The original vegetation consisted of mid and short grasses growing on open land.

Decreasers make up about 55 percent, by weight, of the climax vegetation, and increasers make up about 45 percent. The decreasers are twoflowered trichloris, four-flowered trichloris, Arizona cottontop, pink pappusgrass, and lovegrass tridens. Among the increasers are buffalo-grass, curly mesquite, Texas bristlegrass, perennial three-awn, and many scattered stands of guajillo and cenizo.

If the condition of the range deteriorates, the site is invaded by red grama, whorled dropseed, gummy love-grass, and hairy tridens and, in many areas, saladillo. Among the woody invaders are tasajillo, blackbrush, amargoso, and screwbean.

Where this range site is in poor condition, natural recovery is slow. After the sod has been broken and the brush has been controlled, seeding is generally successful.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 400 pounds per acre, air-dry weight, in unfavorable years to 3,000 pounds in favorable years.

Saline Clay Range Site

The soils that make up this site are deep and moderately deep, nearly level to undulating clays. They are salty at a depth of more than 10 inches, and consequently, the available water capacity and the effective rooting depth are reduced. There are varying degrees of salinity in the surface layer because of the local influence of position, runoff, erosion, and past grazing use. Small amounts of rain are not effective, because of the shallowness of water penetration.

The original vegetation consisted of mid and short grasses growing on open land.

Decreasers make up about 50 percent, by weight, of the climax vegetation, and increasers make up about 50 percent. The decreasers are twoflowered trichloris, alkali sacaton, Arizona cottontop, pinhole bluestem, white tridens, pappusgrass, and vine-mesquite. Among the increasers are buffalograss, curly mesquite, Texas bristle-grass, tobosagrass, and whorled dropseed.

If the condition of the range deteriorates, the site is invaded by red grama, annual weeds, annual three-awn, and gummy lovegrass. As the salinity of the surface layer increases, saladillo and dwarf screwbean become dominant. Other invaders are woody species of pricklypear, amargoso, tasajillo, and mesquite.

This site is preferred for grazing by domestic livestock because of the accessibility and the natural fertility. `When this site is grazed with other sites, distribution of grazing is a problem. It is difficult to maintain sufficient cover and litter to keep salt from accumulating on the surface as water evaporates. Where the range is in poor condition, this site is slow to recover. Successful seeding is difficult because seedlings fail to germinate or to survive during the first dry period.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 450 pounds per acre, air-dry weight, in unfavorable years to 3,000 pounds per acre in favorable years.

Sandy Loam Range Site

The soils that make up this site are moderately deep and deep, nearly level to gently sloping fine sandy loams. The original vegetation was open grassland.

The climax or potential vegetation is chiefly a mixture of short and mid grasses. Decreasers make up about 65 percent, by weight, of the climax vegetation, and increasers make up about 35 percent. The main decreasers are Arizona cottontop and fourflowered trichloris. Other decreasers are tanglehead and lovegrass tridens. Among the wide variety of increasers are hooded windmillgrass, bristlegrass, slim tridens, pink pappusgrass, sand drop-seed, knotroot panicum, slender grama, and fall witchgrass.

If the condition of the range deteriorates, the site is invaded by red grama, annual weeds, whorled dropseed, red lovegrass, Halls panicum, lotebush, prickly-ash, and coyotillo brush. Other common invaders are mesquite, spiny hackberry, Texas persimmon, and a wide variety of other thorny brush.

There are few problems in the management of grazing on this site. The distribution of grazing is generally good. The site responds well to deferred grazing. The supply of forage is good at any time of the year when there is sufficient moisture because there is a wide variety of vegetation. Seeded grasses can be successfully established after brush has been controlled.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 1,000 pounds per acre, air-dry weight, in unfavorable years to 5,000 pounds per acre in favorable years.

Sandy Mound Range Site

This site consists only of Falfurrias fine sand, a deep, gently undulating to rolling soil. This soil is highly susceptible to soil blowing and, when bare, may require special treatment. There are stabilized sand dunes in some areas and active ones in a few spots.

The original vegetation was open grassland.

Decreasers make up about 70 percent, by weight, of grasses in the climax vegetation, and increasers make up the rest. The decreasers are seacoast bluestem, Gulf dune paspalum, brownseed paspalum, tanglehead, and switch-grass. Among the increasers are perennial three-awn, Pan American balsamscale, fringeleaf paspalum, hooded windmillgrass, and sand dropseed.

If the condition of the range deteriorates, the site is invaded by red lovegrass, partridgepea, silverleaf sunflower, grassbur, and numerous annuals.

Seeding is difficult on this site because, except in the most favorable seasons, the surface layer dries out before the seeds can germinate. In many places sandblasting destroys the seedlings that emerge. Decreaser grasses thin out and lose vigor during periods of drought. Production is poor where the dominant species are shallow-rooted grasses but better where the dominant species are deep-rooted grasses. Careful control of grazing and deferment of grazing are particularly needed after a period of drought. Management of grazing helps to restore the density and vigor of the most desirable plants. The forage produced on this site is of lower nutritive quality than that produced on most other sites.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 1,000 pounds per acre, air-dry weight, in unfavorable years to 4,500 pounds per acre in favorable years.

Shallow Ridge Range Site

This site consists only of Zapata soils, which are very shallow, gently sloping, loamy soils. These soils occupy ridges that are at a slightly higher elevation than surrounding areas. The depth to strongly cemented or indurated caliche ranges from 2 to 10 inches, and in places there are a few rock outcrops. The site is droughty because of the lack of moisture storage and the rooting depth.

The original vegetation was mainly grasses but there were also native stands of woody species of guajillo, cenizo, kidneywood, and ratany.

Decreasers make up about 50 percent, by weight, of the climax grasses, and increasers make up about 50 percent. The decreaser grasses are Arizona cottontop, tanglehead, pink pappusgrass, trichloris, and lovegrass tridens. Among the increasers are Texas bristlegrass, hooded windmillgrass, slim tridens, sand dropseed, and fall witchgrass.

As the condition of the range deteriorates, the site is invaded by an increasing number of woody species of blackbrush, pricklypear, and mesquite. Other invaders are red grama, hairy tridens, gummy lovegrass, red lovegrass, other low-growing, fast-maturing grasses, and annual weeds.

Maintaining a good cover of grass results in more effective use of the limited amount of water that this site can store. This practice is essential in decreasing the runoff and reducing the water loss through evaporation. Seeding and the use of mechanical equipment are restricted by the shallowness to strongly cemented or indurated caliche.

The total annual yield of herbage on this site, in excellent condition, ranges from approximately 500 pounds per acre, air-dry weight, in unfavorable years to 2,500 pounds per acre in favorable years.

Use of the Soils for Wildlife

By ELIAS GUERRERO, district conservationist, Soil Conservation Service.

Wildlife was abundant in Starr County when the early settlers came, but it declined as the area developed. This decline was brought on by wasteful hunting for many years when there were no game laws, by a gradual change in vegetation caused by heavy stocking of the range, and by the decline in range condition as wildlife and livestock competed for forage.

In the last few years, the wildlife population has increased. Management programs that improve the existing food, cover, and watering facilities have been carried out on many ranches. Wildlife is a good secondary cash crop.

Among the wildlife that find habitat in Starr County are white-tailed deer, javelinas, bobwhites, turkeys, scaled quail, mourning doves, cottontails, white-winged doves, jackrabbits, armadillos, opossums, and raccoons. The waterfowl habitat is not significant, but farm ponds, Falcon Lake, and the Rio Grande provide excellent fishing. In the river and in Falcon Lake, the principal species of fish are buffalofish, bass, flathead catfish, and channel catfish, and in farm ponds, redear and bass.

Soils that are suitable for cropland and range are also suitable for wildlife, but even where conservation practices are applied, some soils are more suitable for wildlife than others.

Wildlife specialists are available for assistance in developing habitats for wildlife, through the Starr County Soil Conservation District, the Texas Agricultural Extension Service, and the Texas Parks and Wildlife Department.

The soils in Starr County have been placed in five wildlife groups that are coextensive with one or more soil associations. Each group is unique in topography, kinds and amounts of vegetation, and in principal kinds of wildlife that find habitat there. The soil associations are described in the section “General Soil Map.” The wildlife groups are described in the following paragraphs. The land type Pits is not in a wildlife group.

Wildlife Group 1

This group is coextensive with the Jimenez-Quemado association. These are undulating to hilly soils that occupy gravelly ridges. They are shallow over strongly cemented caliche. These soils support mixed stands of woody vegetation and grasses. Among the woody plants are guajillo, blackbrush, baretta, and kidneywood. The grasses are mainly pink pappusgrass, Arizona cottontop, hooded windmillgrass, and Texas bristlegrass.

The guajillo, blackbrush, and kidneywood along the ridges and drainageways provide browse and cover for deer. Annual grasses and weeds also provide food for deer. Cover is sparse in many places, and there are few deer.

This wildlife group provides choice habitat for mourning doves and quail. Herbaceous plants furnish nesting cover for the quail, and woody plants furnish nesting areas for the doves. The quail, mourning doves, and white-winged doves find abundant seed from the annual grasses and weeds from late in spring through the winter.

The soils in this group make poor sites for constructed ponds, and there are no springs. The only water available for wildlife is at watering places on soils of adjoining wildlife groups.

Wildlife Group 2

This group is coextensive with the Delmita, McAllen-Brennan, and McAllen-Zapata associations. These are deep to very shallow, nearly level to gently sloping, loamy soils that occur on uplands.

Large mesquite, spiny hackberry, ebony, lime prickly-ash, guayacan, Texas persimmon, lotebush, coyotillo, cenizo, and pricklypear provide cover for white-tailed deer and javelina. Arizona cottontop, Texas bristlegrass, lovegrass tridens, fourflowered trichloris, hooded windmillgrass, pink pappusgrass, knotroot panicum, and other short and mid grasses provide grazing for deer.

This wildlife group provides choice habitat for white-winged doves, mourning doves, and quail.

This group supports a better wildlife population than any other group in the county because it provides the vegetation and the protection.

Water for the wildlife population is available at watering places for livestock.

Wildlife Group 3

This group is coextensive with the Catarina-Copita and Copita associations. These are deep and moderately deep, nearly level to undulating fine sandy loams and clays that occur on uplands. These soils support a mixed stand of woody vegetation and grasses. Among the woody plants are mainly small mesquite, ebony, lotebush, blackbrush, allthorn goatbush, kidneywood, guajillo, and pricklypear. Among the grasses, which are mainly short and mid grasses, are plains bristlegrass, feather bluestem, two-flowered trichloris, pink pappusgrass, whiplash pappusgrass, lovegrass tridens, red grama, whorled dropseed, and many annuals.

The blackbrush and guajillo provide browse and cover for deer and javelina. The grasses as well as many annual weeds provide food for deer. Cover is sparse in many areas, and there are few deer. These soils can be managed so that they provide good habitat for wildlife.

Water for wildlife is available at watering places for livestock.

Wildlife Group 4

This group is coextensive with the Sarita association. These are deep, nearly level to gently undulating, sandy soils. This area has the appearance of open grassland, but it has large mesquite and an understory of catclaw mixed with grasses, forbs, and weeds. Among the dominant mid grasses are seacoast bluestem, crinkleawn, brownseed paspalum, knotroot panicum, fringeleaf paspalum, hairy grama, perennial three-awn, sand witchgrass, and red lovegrass. The woody plants are mesquite, catclaw, spiny hackberry, bluewood, and pricklypear.

Even though cover is sparse in many areas, this wildlife group provides an excellent habitat for white-tailed deer, javelinas, quail, mourning doves, rabbits, and other wildlife. There are large amounts of annual weeds, upon which doves and quail feed. Water for wildlife is available only at watering places for livestock.

Wildlife Group 5

This group is coextensive with the Rio Grande-Reynosa association. These are deep, nearly level and gently sloping, loamy soils that occur in low terrace positions and on the flood plains along the Rio Grande and its larger tributaries. These soils usually receive extra water. This area is used predominantly for irrigated crops or irrigated pasture. The native vegetation consisted of a mixture of grasses and a few trees. The woody plants are hackberry, Rio Grande ash, elm, mesquite, retama, and huisache, spiny hackberry, willow, and whitebrush. Among the grasses are fourflowered trichloris, sacaton, plains bristle-grass, Texas bristlegrass, and pink pappusgrass.

This area is a bird sanctuary. The dense heavy stand of brush and underbrush provides a choice nesting area for white-winged doves and songbirds. There are very few deer because most of the soils are intensively cultivated. Some old riverbeds, or “resacas,” that hold water in winter provide a habitat for ducks.

Water for wildlife is available in the river and its smaller tributaries and at irrigation water facilities.

Engineering Uses of the Soils

By BILLY J. GARNER, engineer, and FLAVIO R. GONZALES, engineer, Soil Conservation Service.

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. Information is given in this section about those properties of the soils that affect construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. Among the soil properties most important in engineering are permeability, shear strength, compaction characteristics, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction. The depth to the water table, depth to bedrock, and topography are also important.

Information concerning these and related soil properties is given in tables 3, 4, and 5. The estimates and interpretations of soil properties in these tables can be used in—

1. Planning and designing agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, air ports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

With the use of the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some terms used in soil science, for example, soil, clay, silt, sand, and aggregate have a special meaning in soil science and a different meaning in engineering. These terms and others are defined in the Glossary.

Engineering classification systems

Two systems of classifying soils are in general use among engineers.

The system approved by the American Association of State Highway Officials (AASHO) (1) is based on field performance of soils in highways. In this system, soil materials are classified in seven principal groups. The groups range from A-1, which consists of gravelly soils of high bearing capacity (the best soils for subgrades), to A-7, which consists of clayey soils having low strength when wet (the poorest soils for subgrades). Within each group, the relative engineering value of soils is indicated by group index numbers that range from 0 for the best materials to 20 for the poorest.

The Unified system of soil classification was developed by the Department of Defense (5,11). In this system the soils are identified according to texture and plasticity and are grouped according to their performance as engineering construction materials. The soil materials are identified as gravel (G), sand (S), silt (M), clay (C), organic (0), and highly organic (Pt). Sand mixed with fine-grained, plastic or nonplastic material having a low liquid limit is identified by the symbols SM or SC. Primarily fine-grained and nonplastic or plastic soil materials that have a high liquid limit are identified by the symbols MH and CH. Soils that have a borderline classification are identified by the symbols for both classes such as ML-CL.

Estimated engineering properties

Table 3 gives estimates of physical properties that are most likely to affect engineering practices, but the depth to a water table is not given. The water table is many feet below the surface in most soils, but it is at a depth of less than 3 feet in places in Alluvial land. It is also high in places in a few soils where irrigated, and onsite investigation is needed. The estimates given in this table are based on test data in table 5, on comparisons with similar soils in other areas, and on the results of field tests.

Estimates are given for the percentage of soil materials passing sieves of three sizes.

Permeability refers to the rate of movement of water downward through undisturbed soil. The estimates are for saturated soil that has not been compacted.

The available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, one that tests to less than 7.0 is acid, and one that tests to more than 7.0 is alkaline. Most of the soils in Starr County are alkaline. Reaction is defined in the Glossary at the back of this publication.

The shrink-swell potential is a rating of the ability of a soil material to change volume when subjected to changes in moisture content. The ratings are very low, low, moderate, high, and very high. In general, deep, clayey soils, such as Montell clay, saline, have a very high shrink-swell potential. Clean sand and gravel and other soil materials that have either small amounts of nonplastic to slightly plastic fines or none have a low shrink-swell potential.

The soils are classified in the table according to their hydrologic group, based on intake of water at the end of a long-duration storm in soils that lack the protective effect of vegetation and that were wet and swollen before the storm began. These are groups of soils having similar rates of infiltration of water even when wetted, and similar rates of water transmission within the soil. There are four such hydrologic groups.

Group A consists of soils that have a high infiltration rate, even when thoroughly wetted, and are chiefly deep, well-drained to excessively drained sand, gravel, or both. Such soils have a high rate of water transmission and a low runoff potential.

Group B consists of soils that have a moderate infiltration rate when thoroughly wetted and are chiefly moderately deep to deep, moderately well drained to well drained, and moderately fine textured to moderately coarse textured. Such soils have a moderate rate of water transmission and a moderate runoff potential.

Group C consists of soils that have a slow rate of infiltration when thoroughly wetted, chiefly soils that have a layer that impedes the downward movement of water and soils that are moderately fine textured to fine textured. Such soils have a slow rate of water transmission and a high runoff potential.

Group D consists of soils that have a very slow rate of infiltration when thoroughly wetted, chiefly soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. Such soils have a very slow rate of water transmission and very high runoff potential.

Engineering interpretations

In table 4, soils are rated according to their suitability as a source of topsoil and road subgrade. Also listed are the degree of limitation and the features affecting the suitability of the soils for specific engineering purposes, the soil features affecting suitability for specific farm structures, and the corrosivity to uncoated steel and concrete. These interpretations are based on the test data in table 5, on the estimated engineering properties in table 3, and on field performance.

As a source of topsoil, the suitability of many soils is rated good. This rating indicates that the soil material is fertile and, ordinarily, rich in organic matter. This material is used to topdress roadbanks, dams, disturbed areas, gardens, lawns, and other areas where vegetation is to be established and maintained. Ordinarily, only the surface layer is removed for topsoil, but other layers may also be suitable.

Road subgrade refers to soil material used to build up the road grade for supporting base layers. The suitability of a soil as a source of material for road subgrade depends largely on texture, plasticity, shrink-swell potential, inherent erodibility, compaction characteristics, and natural water content. Clayey soils that have a very high shrink-swell potential are difficult to place and to compact. These soils are rated poor as a source of road subgrade.

The soil features that affect the use of soils for highway location and that determine the degree of limitation for this use were selected on the basis of estimated soil classification. Soils that have a layer of plastic clay, such as Catarina soils, have a very high shrink-swell potential that adversely affects their use for highway location.

The soil features that affect the use of soils for low buildings and that determine the degree of limitation for this purpose are those of an undisturbed soil. They affect the capacity of the soil to support low buildings and normal foundation loads.

The degree of limitation for septic tank filter fields and sewage lagoons is based on the soil features that determine capacity to absorb effluent. These soil features are permeability, depth to water table, flooding hazard, slope, and depth to rock or other impervious material that may cause pollution of the water supply.

The soil features affecting the suitability of soils for dikes, levees, or embankments for farm ponds and determining the degree of limitation for these uses are plasticity, stability, susceptibility to seepage, and erodibility. Soils that are predominantly highly plastic clay have low strength and stability when wet. They may be used for impervious cores and blankets, but they should not be used in embankments, unless they are mixed with more suitable material.

The soil features affecting the suitability of the soils for farm pond reservoir areas are those that affect the seepage rate. Among these features are permeability and depth to permeable bedrock or caliche.

Among the soil features affecting use of soils for irrigation are intake rate, available water capacity, depth of the soils, salinity, slope, susceptibility to water, erosion, and flooding hazard.

The soil features that affect use of the soils for terraces and diversions are depth to bedrock or other unfavorable material, texture, and stability.

Grassed waterways are established to carry off excess water discharged from terraces, diversions, and other areas. Some soils are adversely affected for this use by shallowness to caliche. They are droughty (low available water capacity), and, consequently, are difficult to vegetate.

The corrosivity ratings of the soils to uncoated steel and concrete are given in table 4. Steel pipe placed in any soil in the county should have a protective coating to retard corrosion.

Although not shown in table 4, a few soils in the county are sources of sand, gravel, or caliche. Soils of the Falfurrias and Sarita series and Alluvial land are sources of sand; soils of the Jimenez and Quemado series are sources of gravel; and soils of the Delmita and Zapata series are sources of caliche. Onsite investigation may be needed to find material that meets the desired requirements.

Engineering test data

Table 5 gives the engineering test data for samples taken from seven selected soil profiles. The tests were performed by the Texas State Highway Department Testing Laboratory according to standard procedures of the American Association of State Highway Officials. The test data indicate the characteristics of the soil at a specific place, but the same soil probably has similar characteristics in other places.

As moisture leaves a soil, the soil decreases in volume in proportion to the loss in moisture, until a point is reached where shrinkage stops even though additional moisture is removed. The moisture content at which shrinkage stops is called the shrinkage limit. The shrinkage limit of a soil is a general indication of the clay content; it decreases as the clay content increases. In sand that contains little or no clay, the shrinkage limit is close to the liquid limit and is considered insignificant. As a rule, the load-carrying capacity of a soil is at a maximum when its moisture content is at or below the shrinkage limit. This rule does not apply to sand, because, if confined, sand has a uniform load-carrying capacity within a considerable range in moisture content.

Lineal shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the stipulated percentage to the shrinkage limit.

The shrinkage ratio is computed by dividing the amount of volume change resulting from the drying of a soil material by the amount of moisture lost through drying. The volume change used in computing shrinkage ratio is the change in volume that takes place in a soil when it dries from a given moisture content to a point where no further shrinkage takes place. The ratio is expressed numerically.

In mechanical analysis the soil components are sorted by particle size. Sand and other granular material are retained on a No. 200 sieve, but finer particles pass through it. Clay is the fraction smaller than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is silt.

Liquid limit and plasticity index indicate the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material passes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic. The liquid limit is the moisture content at which the material changes from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil is plastic.

Formation and Classification of the Soils

This section discusses the factors of soil formation and the classification of the soils. Table 6 shows the classification of the soils by higher categories.

Factors of Soil Formation

The factors that determine the kind of soil that forms at any given point are the climate under which the soil material accumulated and weathered; the living organisms on and in the soil; the composition of the parent materials; the topography, or lay of the land; and the length of time the forces of soil development have acted on the soil material (3). The relative importance of each factor differs from place to place, and each modifies the effect of the other four. In some cases one factor may dominate in formation of a soil.

Climate and living organisms, chiefly vegetation, are the active factors of soil formation. They alter the accumulated soil material and bring about the development of genetically related horizons. Topography, mainly by its influence on temperature and runoff, modifies the effect of climate and vegetation. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil. Usually, a long time is required for the development of distinct horizons.

Climate

Rainfall, temperature, humidity, and wind have been important in the development of soils in this county. The wet climate of past geologic ages has influenced the deposition of parent material, but the climate changed and there has been only limited rainfall in later geologic times.

Today, many of the soils are shallow to a horizon of calcium carbonate accumulation because moisture seldom penetrates below the root zone. Some soils have lime throughout the profile because not enough water moves downward to leach out the lime.

Wind has affected the development of soils by blowing sand over preexisting sediments. The sandy soils of the Sarita and Falfurrias series formed in windblown material.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soil. Gains in the content of organic matter and in the supply of nitrogen, gains and losses in the supply of other plant nutrients, and changes in the structure and the porosity of the soils are among the changes governed by living organisms.

In this county the formation of soils has been affected more by vegetation, which is dominantly grass, than by other living organisms. As the grass dies, it contributes a large amount of organic matter to the soil. As the leaves and stems decay, they contribute organic matter to the surface, and as the fine roots decompose they contribute organic matter throughout the solum. The network of tubes and pores left by the decaying roots allows more rapid passage of air and water through the soil and provides abundant food for soil organisms.

The influence of man should not be ignored, because the following practices have had a marked effect on soils in this county in the past hundred years. Severe overgrazing of range has denuded some areas, thus causing excessive runoff and, in some areas, severe erosion. The use of heavy machinery and poorly timed tillage in cultivated areas has compacted the soil and thus retarded aeration, infiltration of water, and the growth of plant roots. Use of the root plow has caused some changes in the physical properties of soils. Land leveling has considerably altered some soil areas, and irrigation has drastically changed the moisture regime in some soils.

Parent material

The parent material of most soils in this county is alkaline or calcareous, unconsolidated material deposited mainly by water, but that of some soils is windblown sand.

There is considerable variation in kinds of sediments throughout the county.

Along the present stream channel of the Rio Grande, there are recent sediments derived from the wide variety of parent rocks within the vast watershed of the river. These sediments are mainly silty and alkaline or calcareous, and they contain a high proportion of weatherable minerals.

On the active flood plains there are highly stratified parent materials that still have the bedding planes indicating depositions from different floods. Camargo soils formed in this material. The Lagloria soils that formed on the smooth terraces above the active flood plain have lime segregations and only weak stratification deep in the soil.

On the high dissected terrace that borders the level terrace along the Rio Grande, the parent material was deposited by ancient, high-velocity streams. It contains a large amount of gravel, consisting of large rounded fragments of chert, quartzite, other minerals, and basalt. Jimenez and Quemado soils formed in this material.

In smooth areas the parent material was calcareous loamy sediments, underlain mostly by the Goliad Formation. It weathered to friable, neutral to alkaline fine sandy loam. Brennan and McAllen soils formed in this material.

From the Los Olmos Creek west to the county line, the parent materials vary considerably because several geologic formations underlie this area. Among these are the Catahoula, Lagarto, and Oakville Formations of the Miocene epoch; the Frio Formation of the Oligocene epoch; and the Cook Mountain, Jackson, and Yegua Formations of the Eocene epoch. Each of these formations has different characteristics and weathers to different parent material. For example, material weathered from the weakly consolidated calcareous sandstone of the Jackson Formation is the parent material of Copita soils, and material weathered from the calcareous, saline clay and shale, probably of the Frio and Yegua Formations, is the parent material of Catarina, Montell, and Viboras soils.

Topography

Topography, or relief, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. In Starr County the topography is generally nearly level, and consequently it does not account for major differences in the soils.

The degree of development of the soil profile depends mainly on the amount of moisture in the soil, provided other factors of soil formation are equal. Sloping soils absorb less moisture, and ordinarily, their profiles consist of less distinctly defined horizons, or layers, than those of level or depressional soils. The formation of steep soils is retarded by continuous erosion, and the formation of level to depressional soils is retarded where they continuously receive sediments.

Time

Most of the soils in Starr County are young. Differences in degree of profile development commonly reflect differences in length of time that parent material has been in place. Differences in age are apparent in the profiles. For example, in soils of the Camargo, Matamoros, Rio Grande, and Zalla series, the stratification of recent sediments as they were laid down in each successive flooding is still apparent. In contrast, in soils of the Brennan and Delmita series, sediments of Pliocene age have been in place a longer time. In these soils clay particles have moved downward into the subsoil, and free lime has been leached from the upper part of the profile. The lime has accumulated at about the depth to which moisture penetrates.

Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (3) and later revised (8). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and September 1968 (10). This system is under continual study, and readers interested in the development of the system should refer to the latest literature available.

The current system of classification defines classes in terms of observable or measurable properties of soils (7). It has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series, particularly in families, may change as more precise information becomes available.

In table 6 the soil series of Starr County are classified according to the current system. Following are brief descriptions of the six categories.

ORDER.—Soils are grouped into orders according to the properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Six of the ten soil orders occur in this county : Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, and Alfisols.

Entisols are recent soils in which there has been little, if any, horizon development. This order is represented in Starr County by soils of the Camargo, Falfurrias, Grulla, Matamoros, Rio Grande, and Zalla series.

Vertisols are soils in which natural churning or inversion of soil material takes place, mainly through the swelling and shrinking of clays. This order is represented by soils of the Catarina, Montell, and Tiocano series.

Inceptisols occur on young land surfaces. This order is represented by soils of the Lagloria, McAllen, and Reynosa series.

Aridisols are primarily soils of dry places. They have a light-colored surface soil, and some have a clay-enriched B horizon high in base saturation. This order is represented by soils of the Copita, Garceno, Jimenez, Maverick, Quemado, Viboras, and Zapata series.

Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 50 percent. This order is represented by soils of the Ramadero and Rio series.

Alfisols have a clay-enriched B horizon and a base saturation of more than 35 percent. This order is represented by soils of the Brennan, Comitas, Delmita, and Sarita series.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The soil properties used are mainly those that reflect either the presence or absence of waterlogging, or differences in climate or vegetation. The climatic range of the suborders is narrower than that of the orders.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major horizons and soil features. The horizons considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the growth of roots or the movement of water. Among the features considered are the self-mulching properties of clays, soil temperature, and chemical composition (mainly calcium, magnesium, sodium, and potassium).

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils when used for engineering purposes. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

Climate

By ROBERT B. ORTON, State climatologist, National Weather Service.

Starr County has a warm-temperate, subtropical steppe climate and only a short humid period in summer. Even though the county is only about 70 miles west of the Gulf of Mexico and airflow from the Gulf is largely dominant, the climate has few, if any, marine characteristics. Westward from the Gulf of Mexico, humidity decreases so that the climate in this county is less humid than that in other counties in the lower valley of the Rio Grande.

Table 7 shows precipitation data, and table 8 shows temperature data. These data are based on records at Rio Grande City.

The average annual rainfall is only about 17 inches. Most of the precipitation is in the form of thundershowers and, consequently, is unevenly distributed both geographically and seasonally. Wide variations in rainfall occur within relatively small areas. Occasionally, a tropical disturbance produces heavy rains early in fall; consequently, rainfall averages are highest in September. The next rainfall “peak” occurs late in May or early in June during the period of squall-line thunderstorms. The driest months are November and December. Because of the generally inadequate and variable rainfall, it is necessary to use supplemental irrigation water for successful farm production.

Summer temperatures are high, and the daily maximum temperature in July and August is usually 100° F. or above. Winter temperatures are pleasantly mild, and low temperatures at night are usually in the upper 40's. Freezing temperatures do not occur every year. On an average, a fall freeze will occur in 7 years out of 10 and a spring freeze in about 9 years out of 10. The average length of the growing season, or freeze-free period, is 305 days. There have been severe cold spells that have caused extensive damage to crops, fruits, and vegetables, but these spells are quite rare. One of the most severe cold spells occurred in January 1962 when the temperature went down to 10° F.

The annual relative humidity averages between 65 and 70 percent. There is a small variation in relative humidity from month to month, but the average relative humidity is lower in March and April and in July and August than in other months. The daily values are usually highest early in the morning just before sunrise and lowest in midafternoon.

The percentage of possible sunshine averages between 60 and 65 annually and rangers from about 50 in January to 80 in August. Lake evaporation averages between 66 and 74 inches each year and increases with increasing distance from east to west across the county.

Hurricanes that enter the western part of the Gulf usually follow a north-south path just offshore and, consequently, occur with very low frequency in this county. As such storms move inland, wind velocities usually diminish rapidly so that the main effect of such storms in the county is heavy rainfall. In the 68-year period from 1896 to 1963, no tornado was known to have touched ground in the county, but a few funnels were observed aloft. Hailstorms and windstorms are extremely rare.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is poor from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Arroyo. A creek that remains dry, except during rainy periods.

Available water capacity. The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedding planes. The arrangement of sediments in layers, strata, or beds. Usually, a synonym for stratification.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonym : clay coating.

Concretions. Grains, pellets, or nodules of various sizes. shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Drainage that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A horizon and upper part of the B horizon and have mottling in the lower part of the B horizon and in the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time. If Podzolic, they commonly have mottling at a depth below 6 to 16 inches, in the lower part of the A horizon, and in the B and C horizons.

Poorly drained soils are wet for long periods; they are light gray and generally mottled from the surface downward, but some have few or no mottles.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Dryfarming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding, unless protected artificially.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

These are the major horizons—

0 horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A. to the underlying C horizon. The B horizon also has distinctive characteristics caused by (1) accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Hummocky. Irregular or choppy topography characterized by small dunes or mounds that have side slopes of 3 to 10 percent and are 5 to 15 feet high.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are none, very slow, slow, medium, rapid, and very rapid.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Laguna. Locally, a small, generally rounded, undrained depression about 3 to 10 feet lower than the surrounding area. Synonym: playa.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 to 15 millimeters (about 0.2 to 0.6 inch diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Outwash. A mantle of soil material washed from areas of higher elevation by ancient streams.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism. or a block, in contrast to a clod.

Permeability. The quality that enables a soil horizon to transmit water or air. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid.	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline.	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline.	9.1 and higher.

Relief. The elevations or inequalities of a land surface, considered collectively.

Resaca. Locally, a meander bend or oxbow formed by an old river channel that has been cut off and gradually plugged at each end.

Root plowing. Plowing of rangeland with large machinery in such a manner that roots are cut several inches below the soil surface, thus destroying brushy plants with a minimum of disturbance to the soil.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but the sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

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